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SCIENCE EDUCATION.—*Establishment of graduate study courses at the National Bureau of Standards.*[1] HARVEY L. CURTIS.

The first graduate study courses given at the National Bureau of Standards began about October 1, 1908. Every year since then at least three courses have been given. During the 1948–49 year, eight courses were given outside official hours for the primary purpose of enabling employees to present them to some university as credit toward an advanced degree. Moreover, other Government agencies have established similar courses, in all cases making use of the pioneer work at the Bureau of Standards. Because of this wide interest, it seems desirable to record some of the experiences of those who were instrumental in getting this work under way. Because so much of the material to be given depends on the author's memory, the article is presented as a personal narrative.

It is my belief that the graduate study courses were the brain child of Dr. S. W. Stratton, first director of the Bureau of Standards, although there is no record or even tradition of the early development of the idea of such courses. The oldest information concerning Dr. Stratton's idea of establishing such courses is my remembrance of a conversation with him in July 1907 in which he gave expression of the underlying principles of the courses. I had been offered a position at the Bureau, but before accepting I came to Washington to investigate the desirability of so doing. I had a conference with Dr. Stratton in which he outlined the plan of having graduate courses at the Bureau and of permitting the use of official research work as material for a thesis. The plan appealed to me, and the possibility of obtaining a doctor's degree by means of it was an important incentive in bringing me to the Bureau.

[1] Received July 22, 1949.

I feel sure that Dr. Stratton, before that time, discussed the subject of graduate courses not only with members of his own staff but also with some of the leaders in collegiate physics. The only member of his staff who is now known to have taken an active interest was Dr. E. B. Rosa, chief physicist of the Bureau, who insisted that the work be on a high plane and who conducted one of the early courses. Many of the leaders in collegiate physics came to the Bureau every spring after 1906 to meetings of the American Physical Society. Some of the regular attendants were Ames of Johns Hopkins, Webster of Clark, Millikan of Chicago, Nichols and Merritt of Cornell, and D. C. Miller of Case School of Applied Science. From later developments I think that Dr. Stratton received encouragement at least from Ames and Webster. Doubtless many with whom he talked were opposed to the idea. In support of this, I recall a letter received in the summer of 1908 by one of the junior members of the staff, who wrote to a university where he had been a student to inquire if work done in Bureau courses would be accepted there as credit toward an advanced degree. Not only was the reply most emphatically negative, but the writer proceeded to denounce the whole project, saying that in his estimation it was merely a plan to sell degrees. This letter, which has now disappeared, was seen by only two or three of the staff, all juniors, and was considered by them as "top secret." Nevertheless, by 1907 Dr. Stratton had received enough encouragement to believe the plan was workable.

Before graduate courses were established some universities had accepted research work done at the Bureau as a basis for a Ph.D. thesis, although all instructional work

was taken at the university. In this way, E. P. Hyde received his Ph.D. degree from Johns Hopkins University in 1906, C. W. Burrows from the University of Michigan in 1907, and F. W. Grover from George Washington University in 1907. The first written evidence that I can find concerning the establishment of graduate courses is a letter to me dated February 27, 1908, from Professor Carhart of the University of Michigan. I quote it in full:

MY DEAR CURTIS:

At a recent meeting of the Graduate Council, of which I am a member, I was instructed to write to you in relation to your recent letter of inquiry, and to ask you to give us information as soon as you can relative to Dr. Stratton's plan for a year's work at the Bureau of Standards toward the Doctor's degree. At the same time the Council wished it understood that it is prepared to consider such a plan favorably.

The Council was uncertain as to how much is to be included in the year's work. It is clear that the work on a thesis may be done, but how will the other work necessarily going on with the thesis work be superintended?

Please give me any information you may have, or can obtain as soon as convenient.

Very truly yours,
HENRY S. CARHART.

I do not have a copy of the letter I wrote to Professor Carhart and to which the above refers. It was probably written in January 1908. I replied to the above on March 6, saying that at the moment plans were too indefinite to furnish the information desired but that I would write again as soon as plans were completed.

This favorable letter, and perhaps others, stimulated the activities of the junior members of the staff of the Bureau of Standards. A meeting was held and the "Association for Graduate Study" organized, with the following officers elected: President, H. L. Curtis; secretary-treasurer, R. Y. Ferner[2]; members of the executive committee, P. G. Agnew[3] and E. C. McKelvy.[3]

The principal purpose of the association was to prod Dr. Stratton so that the plan would get under way while the members were still young. Unfortunately, the early records of this association seem to have been lost.

[2] Deceased.
[3] Now with the American Standards Association.

During the spring and summer of 1908 the officers of the association frequently discussed with Dr. Stratton the organization of suitable courses. He proposed the plan of having a 3-year cycle in physics and in mathematics, a procedure still followed after 40 years. The cycle for chemistry was developed later. It was decided that the initial courses would be differential equations, theoretical mechanics, and thermodynamics, the last being included primarily for the benefit of the chemists. Dr. Stratton suggested suitable men as instructors, but the making of all financial arrangements and the fixing of the hours of meeting were turned over to the association, which was composed entirely of those seeking advanced degrees. Dr. A. F. Zahm was selected for theoretical mechanics and Dr. Edgar Buckingham for thermodynamics. Some difficulty was experienced in securing a suitable Washington man to teach differential equations. Just before leaving in September 1908 to attend the London Electrical Conference, Dr. Stratton authorized me to go to Johns Hopkins University (at my own expense) to secure an instructor in differential equations. At his suggestion I conferred with Dr. J. S. Ames, professor of physics, and was able to obtain Dr. J. A. Anderson. He was an excellent instructor and continued to teach courses here for several years. The association fixed the fees at $25 for a course lasting 30 weeks with two hours of instruction a week, the option being given of paying $15 at the beginning of the year and executing a note for the remainder, payable at the beginning of the second semester. The association attempted to make the fees such that the total return would be a maximum.

As soon as definite courses had been arranged, all junior members of the Bureau staff were canvassed to see whether the courses would be supported. The response was much better than had been expected. Men who had taken no previous interest signed up for one or two courses. It was evident before the first lecture was given that there would be a surplus at the end of the year. When Dr. Stratton returned from Europe late in October he was delighted to find the courses under way. The instruction was of high caliber, and the interest of stu-

dents was good. The only contemporary description of that work that I have found is an undated letter I wrote to Professor Carhart during the fall of 1908:

DEAR SIR:

Last February I had some correspondence with you concerning a plan for finishing my work for a doctor's degree by work taken here at the Bureau of Standards. I then wrote you that at that time it was impossible to give details, but that I would supply them when the work was satisfactorily organized.

The work began the first week in October, and is to continue for thirty weeks. For this year four courses are arranged:

(1) Differential Equations, by Dr. Anderson, instructor in Johns Hopkins University.
(2) Thermodynamics, by Dr. Buckingham, author of Buckingham's "Thermodynamics," and a member of the Bureau Staff.
(3) Dynamics, by Dr. Zahm, formerly of the Catholic University. In this we are using Webster's "The Dynamics of Particles and of Rigid, Elastic, and Fluid Bodies."
(4) Laboratory work in Electrical Measurements under the direction of Dr. Rosa.

I am taking courses (3) and (4) and will describe these more in detail. In Dynamics we meet Dr. Zahm for two lectures per week. Besides this we have organized quiz sections and are meeting twice each week for a careful discussion of the text. In the Electrical Measurements a group of three meets for at least four hours of laboratory work per week outside of our regular work. We are also preparing note-books covering the work.

For next year I expect to be able to take courses in the Mathematical Theory of Electricity and in Advanced Mathematics. Dr. Rosa has also expressed a willingness to superintend my thesis, provided that would be acceptable to you.

I would request that you convey this plan to the Graduate Council, and inform me if it meets their approval. In case any further information is desired, I will supply it to the best of my ability.

Yours truly,
H. L. CURTIS.

This letter had been written with the approval of Dr. Stratton, who had made it clear from the first that each student must make his own arrangements for having the work accredited at the university of his choice. The interest in the work continued throughout the year.

From the beginning, the juniors wanted a senior committee to supervise the work. They realized that only with such a committee could they hope to get their work recognized by a university. Hence it was with satisfaction that the juniors learned that a committee had been appointed by the director "to prepare regulations governing the conditions under which graduate work may be given at the Bureau of Standards, including such questions as the method of selecting courses and instructors; methods of collecting and disbursement of funds; the granting of credits; and such other questions as may seem desirable to include in a set of rules and regulations governing the work in question." The committee consisted of Drs. Stratton, Rosa, Hillebrand, Wolff, Waidner, Burgess, Dorsey, Nutting, Waters, Mr. Fisher, and all instructors. The first meeting was held on March 18, 1909, with all members present except two instructors, Drs. Anderson and Zahm, and with the president of the Association for Graduate Studies as a nonvoting guest. The committee held two additional meetings, adopted a plan, and adjourned sine die. If my memory serves me correctly, this committee did not function very harmoniously. I am quite sure that some parts of the plan they adopted have never been put into effect.

The plan provided for a Board of Graduate Instruction, which met for the first time on April 15, 1909. At this meeting Dr. Stratton appointed an executive committee of nine members, with the juniors represented by two members—Curtis and Dickinson. I find no record of a subsequent meeting of the board.

There was some friction concerning the transfer of the money that the juniors had collected to the new organization. I believe that all salaries for the first year were paid by the juniors and that then the surplus was transferred to the new senior treasurer, Mr. Fisher. A report on the first year's work was made by the association to the executive committee of the board.

One feature of the first year's work that has not been repeated at the Bureau was an experimental course in electrical measurements. This was under the supervision of Dr. Rosa, but as he was in Europe during the fall months the work was carried on by the three students. They were fortunately located, Dellinger in the Resistance and Electromotive Force Section, Curtis in the Inductance and Capacity Section, and Agnew in the Electrical Instruments Section. Meetings were one evening a week and lasted from

5 P.M. until the experiment was finished. At least two of the notebooks are still in existence and have occasionally been consulted in the past 40 years. Starting in January 1909 Dr. Rosa gave lectures on advanced electrical measurements, devoting special attention to the methods of computing inductance. These were attended by several who did not participate in the experimental work. It seems to me to be unfortunate that more experimental courses have not been organized.

The method of deciding on courses and instructors for 1909–10 is obscure. The records of the executive committee for that year are lost, and no one seems to remember details. The courses in physics and mathematics were those outlined in my letter (quoted above) to Professor Carhart, which was written before the executive committee was organized. It was natural that Anderson should be asked to continue as an instructor, since he had made an exceptional reputation in the first year. I am of the opinion that the seniors selected Dr. Dorsey to teach electricity and magnetism, and Dr. Kanolt to teach physical chemistry.

Dickinson and I retired from the student organization at the close of the 1909–10 year as both of us received our Ph.D.'s in June 1910. I can not determine who were our successors. Apparently the executive committee took complete control at the beginning of the 1910–11 year. A procedure was gradually worked out that is satisfactory to students and to the executive committee and that is recognized by a number of universities. It is now known as the National Bureau of Standards Graduate School. Several similar graduate schools are now in operation in the various agencies of the United States Government in Washington and vicinity. They are as follows, with the year in which they were established and the number of courses given in 1948:

Department of Agriculture Graduate School, started in September 1921 and now giving 61 courses;

Naval Ordnance Laboratory Graduate Training Program, organized in September 1944 and offering 10 courses;

Naval Research Laboratory Scientific Training Program, begun in September 1944, now with 21 courses;

David Taylor Model Basin Graduate Program, initiated in February 1946, now giving 3 courses;

The Bureau of Ships Graduate Study Program, started in September 1946 and now having 12 courses;

Fort Belvoir Branch of the Catholic University of America at the U. S. Army Engineering Center, organized in September 1947 with 12 courses.

The number of courses given in the preceding list was largely obtained by counting the courses listed in the Scientific Personnel Bulletin. Only about half the courses listed are graduate courses, but all are given outside official hours. Their primary purpose is to aid in getting advanced degrees.

It is a matter of satisfaction to have had a part in starting so useful a movement. I believe that Dr. Stratton conceived the idea but that he received relatively little encouragement from the senior members of his staff. It would have been a failure but for the support of university men like Ames, Webster, and Carhart. Ames was most helpful. He induced one of his best instructors to come to Washington to give courses and recognized the work as the equivalent of that done on his own campus. He encouraged the use of research at the Bureau as material for doctoral theses. Later, when he was stationed in Washington during World War I, he taught graduate courses at the Bureau of Standards and for one year was chairman of the Graduate Study Committee. He once said to me that it was foolish for the universities to refuse to accept a thesis from the Bureau as there was not one of them where the experimental facilities were so complete or the supervision so critical.

Carhart set the machinery in motion by which I obtained my degree at Michigan, even though many faculty members opposed the innovation. Webster was sympathetic. I recall that Dr. Stratton induced him to lecture to a hastily called meeting of the class in dynamics when he chanced to visit the Bureau. Also Dickinson obtained his degree at Clark University using some of the work done at the Bureau. There was encouragement by other university men, but I do not remember specific names or instances.

The graduate instruction at the Bureau and in other Government agencies may be considered as one phase of the demand for making educational facilities more widespread. This demand has been growing for a century or more, starting with elementary grades and extending to the higher fields. The graduate programs in Government agencies fill a need for those who wish to progress to the top of our educational system but who for financial or other reasons can not take the work in a regular educational institution.

ANTHROPOLOGY.—*The last bison drives of the Blackfoot Indians.*[1] JOHN C. EWERS, U. S. National Museum.

At the height of their power, before the middle of the nineteenth century, the three Blackfoot tribes (Piegan, Blood, and North Blackfoot) and their culturally related allies, the Gros Ventre and Sarsi, laid claim to a vast area of grassland immediately east of the Rocky Mountains, extending from the North Saskatchewan River in present Alberta southward to present Yellowstone Park. At its greatest eastward extension Blackfoot territory reached the mouth of Milk River on the Missouri.

That this region formerly was a well-stocked bison hunting ground is proved not only by the testimony of early white explorers and traders on the great abundance of bison in the area, but also by the large number of remains of old bison-drive sites still observable in the region. A bison-drive site generally is now recognized by low piles of rocks placed at intervals of several feet in two lines extending for hundreds of yards over flat or gently rolling plains in a great V shape, converging at the top of a cliff. At the base of the cliff, under soil and talus accumulations is a bed of bison bones. At such sites groups of Indian hunters working in cooperation lured and/or drove herds of bison into the stone-bordered funnels and over the cliffs to destruction in the valleys below. These sites have been variously referred to as "drives," "pounds," "parks," "traps," "falls," and "kills." The Blackfoot Indians term such a site "piskun," which Grinnell (1892, p. 228) translated "deep-blood-kettle."

Although the existence of a number of these sites has been known to anthropologists for many years, no comprehensive effort has been made to locate and enumerate all such sites within the former Blackfoot territory. With the exception of two sites in the valley of the Yellowstone River near the town of Emigrant in Park County, Mont., partially excavated by Dr. Barnum Brown, of the American Museum of Natural History, and briefly reported by him in an article in Natural History Magazine in 1932, none of the bison-drive sites of this area has been systematically explored by scientifically trained persons. However, the sites have attracted many relic hunters, both Indian and white, searching for arrowheads. Some sites also have been despoiled by enterprising individuals, who have used both hand and power equipment to gather bison bones for sale to commercial fertilizer manufacturers. A few seriously interested amateur archeologists have dug into the bone pits. One of them, the late H. P. Lewis, of Conrad, Mont., located some 24 bison-drive sites in the neighborhood of the Sun, Madison, Teton, and Marias Rivers and their tributaries in Montana. Yet Mr. Lewis himself recognized that he had recorded only a portion of the total number of these sites remaining within the area of his search. (Lewis, MS.)

Stone arrowheads of a variety of sizes, shapes, and materials are the artifacts most commonly found at these sites. Mr. Lewis was impressed by the fact that he had found no objects of metal and no materials suggesting Indian contact with the horse in the bone beds. The findings of the relic hunters and bone collectors appear to have been similar to those of Mr. Lewis. During 3½ years' residence within the area, at Browning, Mont., we heard only one vague and doubtful claim that trade materials (a few blue beads) had been found in a bone bed at

[1] Received July 18, 1949.

a bison-drive site. The apparent absence of metal arrowheads or other objects of white manufacture in these sites has caused local enthusiasts to look upon them as prehistoric and possibly of considerable antiquity.

That projectile points of Folsom, Yuma, and other apparently early types have been found in association with extinct as well as modern bison species at other sites on or near the western portion of the plains to the southeast of the region under consideration is well known. However, Dr. Brown said of the bison drive sites near Emigrant, "There is no evidence of great antiquity in this discovery for the Bison were the living species, but the form of the arrows indicated that they were not made by the Indians who inhabited that region at the time of white settlement. Several implements were found by other people on the camp sites, among them a steatite bowl (found and owned by the proprietor of the Wanagen Store, a few miles from the buffalo jumpoff site). Such vessels were used by the Shoshone Indians, but not by the Blackfoot tribe who recently inhabited this region. The arrows were probably not more than two or three hundred years old" (Brown, 1932, p. 81). Obviously the age of each bison-drive site within the former Blackfoot area must be determined on its own merits after careful investigation by trained and experienced archeologists.

Dr. Brown's statement that an artifact of Shoshonean type was found in the vicinity of the Emigrant buffalo drives may have particular significance. Other tribes than the Blackfoot and their allies are known to have hunted bison in the area under consideration both before and during Blackfoot occupancy. The Blackfoot tribes probably did not move southwestward from the present province of Saskatchewan into this area until the middle or late eighteenth century (Thompson, 1916, p. 348). Prior to the Blackfoot push into the area it was held by the Kutenai, Salish (Flathead and Pend d'Oreille), and Shoshone (ibid., pp. 327–328; Teit, 1930, pp. 303–307). As late as 1800 the southern boundary of Blackfoot territory extended but a few miles below the present Montana-Alberta boundary (Thompson, 1916, pp. 345–346; Wissler, 1910, p. 12). The Salishan tribes as well as the Kutenai and Nez Percé dwelling west of the mountains continued to cross the Rockies on periodic bison-hunting excursions into the area claimed by the Blackfoot until bison were exterminated in that region.

What few ethnological data have been obtained from those tribes regarding their use of bison drives are somewhat contradictory and largely negative. We have found no contemporary description of the use of bison drives by any of those tribes. Lemhi Shoshone informants stated in 1906 that the Blackfoot method of driving a herd down a ledge was unknown to their people (Lowie, 1908, p. 185). Teit (1930, pp. 103, 347) obtained information to the effect that the Flathead and Coeur d'Alêne formerly stampeded bison over cliffs, but he could not determine whether they used that hunting method before the advent of the horse. Turney-High's Flathead informants denied that their ancestors drove bison over cliffs or into pounds (Turney-High, 1937, p. 115). The modern Kutenai denied that members of that tribe drove bison over cliffs in the period before the acquisition of horses, even though that method was mentioned in tribal folklore (Turney-High, 1941, p. 36).

The use of buffalo drives by the Blackfoot tribes and their allies, on the other hand, can be proved by numerous references in the literature, some of them from the writings of firsthand observers. Blackfoot use of drives can be traced through the historic period until a relatively short time before the extermination of the bison in their territory. Our field notes, based on the testimony of elderly Indians on the Blackfeet Reservation in Montana, obtained within the past decade, help to establish the terminal dates of the use of bison drives by the Blackfoot.

The earliest historic reference to the use of bison drives by the tribes of the northwestern plains appears in the Journal of Mathew Cocking, a Hudson's Bay Company trader, who visited a Gros Ventre "beast pound" in the western part of the present province of Saskatchewan in the fall of 1772. He described this pound as "a circle fenced round with trees laid one upon another, at the foot of an Hill about 7 feet high & an hundred yards in Circumference; the entrance on the Hill-side where the Animals can easily go

over; but when in, cannot return: From this entrance small sticks are laid on each side like a fence, in form of an angle extending from the pound; beyond these to about 1½ mile distant. Buffalo dung, or old roots are laid in heaps, in the same direction as the fence: This pound was made by our Archithinue friends last spring, who had great success, Many Skulls & Bones lying in the pound." Although Cocking spent a month and a half near this pound, during which numerous attempts were made to drive bison into it, both by members of his party and by some 28 lodges of Gros Ventre, very few animals were driven into the corral. On December 6, he reported, "no success in pounding; the Strangers say the season is past" (Cocking, 1908, pp. 109–113).

On their journey up the Missouri across the present Montana in the spring of 1805, the Lewis and Clark party observed a drive site of different character on the north side of the Missouri between the mouths of the Musselshell and Marias Rivers. Under date of May 29, 1805, Captain Lewis reported, "Today we passed on the Star'd side the remains of a vast many mangled carcases of Buffalow which had been driven over a precipice of 120 feet by the Indians & perished; the water appeared to have washed away a part of this immence pile of slaughter and still there remained the fragments of at least a hundred carcases, they created a most horrid stench" (Lewis and Clark, 1904, vol. 2, pt. 1, p. 94).

The fur trader Alexander Henry visited a North Blackfoot "pound" at the elbow of the Vermilion River in present Alberta, December 20–22, 1809. He did not describe the construction of that pound but commented upon the mangled carcasses left in it from a previous drive. "The bulls were mostly entire, none but the good cows having been cut up." During his stay at the site the Indians were unsuccessful in luring buffalo into the pound, giving as the reason for their failure that the wind was from the wrong direction and the "smell of the smoke from the camps turned buffalo back before they approached, as soon as they scented the smoke." Yet the day after Henry left the site he received word that he had "scarcely left when a large herd was brought in" (Henry and Thompson, 1897, pp. 576–7).

Writing of the Piegan in 1811, the same author stated, "In winter . . . they disperse in small camps of 10 to 20 tents, make pounds for buffalo, and hunt wolves and kits. . . . So much do these people abhor work that, to avoid the trouble of making proper pounds, they seek some precipice along the bank of the river, to which they extend their ranks and drive the buffalo over it. If not killed or entirely disabled from the fall, the animals are generally so much bruised as to be easily dispatched with the bow and arrow" (ibid., pp. 723–25).

While at Fort McKenzie on the Missouri in the fall of 1833, Prince Maximilian of Wied was told by the Blackfoot of their methods of hunting bison "for which they make in the winter season, large parks into which they are driven" (Maximilian, 1906, vol. 23, p. 108).

When writing of the bison during his visit to Fort Union on the upper Missouri in 1843, the naturalist Audubon stated, "The animal is pounded, especially by the Gros Ventres, Black Feet and Assiniboins" (Audubon, vol. 2, pp. 145–146). This is the last contemporary mention of the practice by the Blackfoot and their allies. When Edwin T. Denig described the use of bison pounds by the Assiniboin in 1854, he said, "We know of no nation now except the Assiniboin and Cree who practice it, because all the rest are well supplied with horses that can catch the buffalo, therefore, they are not compelled to resort to these means to entrap them" (Denig, 1930, p. 532). When Lieutenant Bradley wrote briefly of Blackfoot bison hunting in the mid-seventies he used the past tense in referring to this method. "The usual manner of hunting buffalo was by making pens at the edge of a precipice and driving the animals over, sometimes killing them by hundreds and even thousands. The Indians were very expert in driving them long distances by means of mounted warriors" (Bradley, 1923, p. 256).

The most complete descriptions of Blackfoot use of the piskun were based upon the testimony of informants obtained by George Bird Grinnell (1892, pp. 228–232) and Clark Wissler (1910, pp. 34–38) after bison were exterminated. Grinnell distinguished three types of piskun, each adopted to a particular hunting terrain. The North Blackfoot, who

hunted to a considerable extent on relatively level ground, built their piskun like that of the Cree Indians in the form of a corral with rising timbered causeway leading up to the entrance of the corral from which there was a sheer drop of about 4 feet into the corral. The Piegan and Blood, living in more broken country nearer the mountains, drove the bison over cliffs. If the cliff was not a high one they built a corral at its base to prevent the animals' escape. But if the cliff was of sufficient height to insure the death or serious injury of the bison as result of their fall, no corral was necessary.

The descriptions previously quoted indicate that in historic times, after they obtained horses, the Blackfoot employed the piskun primarily late in fall and early in winter. At that season the Blackfoot tribes were divided into hunting bands comprising small fractions of the total tribal populations, engaged in collecting adequate supplies of meat for subsistence through the prolonged winter of snow and ice and bitter cold. In the Blackfoot country the severe winter period usually does not begin until the last week of December or early in January. The dated references to the use of drives in the early contemporary accounts of Cocking and Henry refer to its employment no later than December. Cocking was told on December 6 that the season for pounding was already past. This seems to confirm the testimony of Piegan informants to S. A. Barrett that "the Indians had certain spots where the fixed winter camps were established in the fall of the year. At this season the buffalo were fat and prime and the drives to secure a winter's food supply were usually held immediately after this fixed camp was established" (Barrett, 1922, p. 23).

The survival of the use of the piskun among the Piegan can be dated with considerable accuracy. Grinnell stated that in 1892 "many men were still living who have seen the buffalo driven over the cliff." He estimated that "the piskun was in use up to within thirty five or forty years ago" among the Piegan (Grinnell, 1892, p. 230). That would have been until about 1852–1857. Wissler (1910, p. 36) said that none of the Piegan informants who described the use of the piskun to him had taken part in a drive. However, Barrett found in 1921 that "two of the oldest men on the reservation claimed that they had themselves, when very young men, participated in buffalo drives" (Barrett, 1922, p. 27). In 1943 there was no Piegan living on the Blackfeet Reservation in Montana who had witnessed a buffalo drive. Nevertheless, the story of the destruction of the last Piegan piskun was known to a number of the older Indians. The following account of this event was obtained from Lazy Boy (born about 1855; died 1948) in 1943. At that time Lazy Boy was the oldest member of the Piegan tribe.

This happened when I was a baby. My father told me about it, and I have heard the story many times since from the old people.

The Piegan band called Never Laughs was camped on the Teton River a few miles north of the present town of Choteau. Their chief announced, "Now we are going to make a buffalo fall." They built a corral below the cliff and piled rocks in a great V shape on the slope above the fall. They chose the man who was to lead the buffalo to the fall. But each time he lured them in between the lines of rocks they broke away before they reached the cliff edge. After this had happened three times, young Many Tail Feathers became angry. That night he made a fire and burned the corral.

That same night a war party started from camp. Many Tail Feathers followed it. When he caught up with the war party the leader told him, "You go back home. Everybody is against you because you burned the corral."

Many Tail Feathers returned to the Teton River, to Harm Hill. He slept on top of it that night seeking a vision, but no dream came to him. A second night he slept there. In his dream he saw two young boys coming toward him. They asked him, "Are you the man who saved all the women and children?" He answered, "Yes." As the two boys walked away he saw them turn into buffalo. On the third night he saw in his dream a group of people, men, women, and children, dancing toward him. Their leader wore a handsome red war bonnet. When he came near, the leader asked, "Are you the man who saved all the buffalo by tearing up the corral?" Many Tail Feathers replied, "Yes." Then the leader said, "We are the buffalo. For saving all our men, women and children we thank you. I give you my bonnet—the red war bonnet." The group turned

away. Before they disappeared they turned into buffalo. Two scabby bulls, running behind the rest, turned back and gave Many Tail Feathers their power too.

After Many Tail Feathers returned to camp he set about collecting material to make up the bonnet he had been given in his dream. Every bird gave him one of his feathers to put on the bonnet. It was a straight-up bonnet, decorated with weasel hides, red flannel and brass tacks as well as feathers. It looked so pretty all the men wanted it. But Many Tail Feathers kept it for his own. He wore it to war many times before he transferred it to another man.

Many Tail Feathers, the son of the second chief of the Never Laughs band, was a young man at the time he burned the corral near Choteau. He had a fine war record. According to Richard Sanderville he died about 1888. His red war bonnet, one of the most respected sacred headdresses of the Piegan, was transferred to another Piegan before the end of intertribal warfare. It proved unlucky to its later wearers. One owner was killed by the Crow while wearing it, and the enemy took the bonnet from his head. The bonnet was remade by the dead man's father and brother, Calf Tail. Calf Tail was accidentally killed while hunting buffalo, and the bonnet was buried with him. Still later in the nineteenth century the bonnet was again remade. This bonnet is now in the collections of the Museum of the Plains Indians, Browning, Mont. (catalog no. 176). Doubtless the interest of the Piegan in the origin and history of the sacred red war bonnet has helped to fix in their memory the last bison drive of their tribe.

Elderly Piegan informants acknowledged that the North Blackfoot of Canada continued to make use of the piskun for a number of years after the Piegan abandoned it. During the summer of 1947, Weasel Tail, an aged Blood Indian, then living on the Blackfeet Reservation in Montana, related his own experiences as a participant in these later bison drives. His account is of value for its detailed description of the drive as well as for the light it sheds on the survival of piskun use among the Canadian Blackfoot:

Twice I have seen buffalo corralled. The first time I was a small boy about four years old. We were camped near the North Piegan in the Porcupine Hills west of the present town of Macleod (Alberta). I don't remember anything about it except that I saw the dead buffalo in the corral and that I fell over one of the pointed stakes projecting into the corral and cut a bad gash in my forehead just over my right eye. You can still see the scar.

The second time I was about 15 years old. I killed one of the buffalo in that corral with a gun. I remember it well.

I was then among the North Blackfoot near present Gleichen (Alberta). It was in winter. We didn't drive the buffalo over a cliff. We built a corral near the edge of timber toward the bottom of a downhill slope. We made the corral of cottonwood posts set upright in the ground to a height of about 7 feet, and connected by crosspoles of cottonwood or birch tied to the posts with rawhide ropes. All around the corral stakes of cottonwood or birch were laid over the lowest crosspoles. Their butt ends were firmly braced in the ground outside the corral. Their other ends projected about 3 feet or more inside the corral at an angle so that the ends were about the height of a buffalo's body. These ends were sharpened to points, so that if the buffalo tried to break through the corral, after they had been driven into it, they would be impaled on the stakes. From the open side of the corral the fence of poles extended in two wings outward and up the hill. These lines were further extended by piles of cut willows in the shape of little lodges tied together at the tops. These piles were about half as high as a man and were spaced at intervals of several feet. On the hill just above the opening of the corral a number of poles were placed on the ground crosswise of the slope and parallel to each other. The buffalo had to cross these poles to enter the corral. These poles were covered with manure and water which froze and became slippery so that once the buffalo were in the corral they couldn't escape by climbing back up the hill.

Before the drive began a beaver bundle owner handled the sacred buffalo stones in his bundle and prayed. He sang a song, "Give me one head of buffalo or more. Help me to fall the buffalo."

Then the men of the camp rode out on horseback, got around behind a herd of buffalo and drove it toward the corral. A man stood at the top of the hill and gave a signal to the women and children, who were hiding behind the willow piles,

when the buffalo were coming. As the buffalo passed them the women and children ran out from their hiding places.

Once inside the corral, the buffalo were killed by men and boys with guns. I believe we killed 33 buffalo that time. Then the camp chief went into the corral to take charge of the butchering and division of the meat. While butchering in the corral the people ate buffalo liver, kidneys, and slices of brisket raw. Two young men took kidneys, liver, brisket, tripe, and manifold to the beaver bundle owner who had prayed for the success of the fall and who had remained in his lodge. Each man who had killed a buffalo in the corral was given its hide and ribs. Then the rest was cut into quarters and the chief divided the quarters among the families in the camp. Each family got the same share, whether the family was large or small. After the buffalo were divided the corral was broken up for fire wood.

I have never heard of a buffalo corral made by any of the Blackfoot tribes since the time of this fall in which I participated. Of course we had plenty of guns then. There were already less buffalo than there had been. We could hunt them on horseback.

Since Weasel Tail, born about 1857, was about 15 years of age at the time of this event, we can date the last bison drive of the Blackfoot at about the year 1872. This was a full century after Mathew Cocking's first description of the use of the piskun by Indians of the northwestern plains. It was only a decade before the bison was exterminated in the Blackfoot country.

In the use of bison drives by the Blackfoot tribes we observe the survival of traditional, prehistoric bison-hunting techniques among the historic peoples. Undoubtedly the drive was devised in prehistoric times as a method of cooperative hunting by pedestrian Indians armed with bows and arrows and/or lances which were most effective at short range. After the Blackfoot acquired firearms and horses in the eighteenth century they possessed more efficient and sure means of killing bison. Nevertheless, they rarely used guns in hunting bison on horseback. They employed the surround and individual chase on horseback in bison hunting during the spring and summer seasons. However, all the Blackfoot tribes continued to make use of the traditional drives in collecting their winter meat supply late in fall. The Piegan abandoned the use of drives in the middle of the nineteenth century. The North Blackfoot, poorest in horses of the three Blackfoot tribes, continued to employ drives until bison were nearly exterminated in their territory.

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PALEONTOLOGY.—*The hinge and marginal pectinations of* Nuculoidea opima *(Hall), type of* Nuculoidea *Williams and Breger.*[1] H. E. VOKES, The Johns Hopkins University.

When Williams and Breger proposed the term *Nuculoidea* for "Nucula-like shells" that "possess characters which place them in an intermediate position between Dall's family *?Ctenodonta* [sic] and Adams' family embracing the later and recent Nuculidae" (1916, p. 173) they specifically mentioned the fact that internal molds of "*Nucula opima* Hall = *Nucula randalli* Hall and authors," the species they designated as the genotype, "show distinctly a well-developed cartilage pit under the umbones." They make no mention of other hinge characters, however, and the presumption is that no specimens showing the hinge were available to them. Further, with respect to the species they describe and refer to their new "subgenus," they specifically add that the hinge features are unknown (op. cit., pp. 175, 177).

So far as I have been able to determine as a result of a hasty check of the literature, no previous or subsequent author has figured or discussed the hinge and internal characters of the genotype species. When, therefore, curatorial work on the collections of The Johns Hopkins University revealed, among several typically bivalved specimens from the "Hamilton Group, Pratt's Falls, New York," a single right valve embedded in a rather soft, dark-gray shaly matrix, advantage was taken of the opportunity of preparing it to the extent of exposing the hinge and inner margins. The nature of the specimen made it seem unwise to attempt to remove it entirely from the matrix, and it was, therefore, not possible to examine the impressions of the musculature. Since, however, this has been described by Williams and Breger from molds (op. cit., p. 173) this omission is not of serious importance.

DESCRIPTION OF THE SPECIMEN

The exterior characteristics of the species are well known and have been several times figured, the latest being in the Shimer and Shrock *Index fossils of North America* (1944, pl. 145, fig. 22). The Pratts Falls specimens show that there is considerable variation in general proportion, with the average tending to be somewhat relatively longer in proportion to the height than the form shown by Shimer and Shrock. The umbos, situated slightly behind the posterior third of the length, are relatively high, with the beaks being direct to very slightly prosogyrate, and have a rather sharp umbonal ridge curving from their anterior side toward the anterior end, but dying out before reaching the shell margin. The ornamentation consists of relatively coarse concentric ridges.

Hinge characters.—The dentition is typically nuculoid in character, with anterior and posterior rows of taxodont teeth separated by a chondrophore. In contrast to most other nuculids, however, the posterior row is only slightly shorter than the anterior. The posterior tooth row is straight, confined to the posterior dorsal margin of the valve, and contains eleven relatively narrow, transverse teeth. The anterior five of these are dorsal to the chondrophore, and are separated by very narrow sockets indicating thin, lamellar teeth in the corresponding position of the left valve. The posterior teeth in this row are separated by sockets essentially as wide as the teeth themselves. The anterior tooth row is straight, except for the posterior end which narrows and curves upward dorsal to the chondrophore. This row has 12 teeth that are heaviest anteriorly and become progressively thinner posteriorly. The anterior tooth is essentially a strong pustule, the next three teeth posterior to this show a slight tendency to be chevron-shaped, the remaining ones are straight and transverse, with the three most posteriorly located teeth being greatly reduced in size above the chondrophore.

The chondrophore itself is broadly triangular, narrower than the tooth rows and, therefore, not projecting. It is the triangular shape of this chondrophore that results in both the anterior and posterior tooth rows passing dorsally above it, with consequent reduction of the teeth themselves. In most genera of the Nuculidae the chondrophore is spoon-shaped, and projects anteriorly, with the result that only the anterior tooth row tends to pass above it with consequent reduction in width and in the size of the teeth born upon it. The only other nuculid forms with

[1] Received June 20, 1949.

a triangular chondrophore are the peculiar little Recent *Brevinucula* Theile, 1934 (monotype, *Nucula* (*Brevinucula*) *guineensis* Theile) and *Nuculopsis* Girty, 1911 (type, *Nucula ventricosa* Hall, 1858 (not Hinds, 1843) = *Nuculopsis girtyi* Schenck (1934, p. 30), a Pennsylvanian species). In this form as figured by Girty (1915, pl. 15, figs. 6, 7) and by Schenck (1934, pl. 2, fig. 19) the chondrophore is wide, broader than the tooth rows, and projects into the cavity of the valve; the anterior teeth are all markedly chevron-shaped, including those that are dorsal to the chondrophore, while the few posterior teeth present are straight. None of these latter are, however, indicated as occupying a position dorsal to the chondrophore itself.

In *Brevinucula* there are no teeth dorsal to the chondrophore, which projects but slightly into the interior of the valve.

Characteristics of the inner margins of the valve.—Williams and Breger, apparently on the basis of the examination of the internal molds available to them, considered this to be smooth and made it the most important character in their distinction of the "subgenus" *Nuculoidea* from *Nucula* s.s. They state (1916, pp. 173–174):

> The Paleozoic nuculoid shells mentioned above agree with Nucula in general outline, configuration, pearly shell, and taxodontic hinge, as well as in having a cartilage pit. . . . However, one of the characters commonly associated with Nucula is the denticulate ventral margin on the interior of the shell. This denticulate or pectinate margin is developed in all the Recent and Tertiary species of Nucula examined by me and Mr. Breger, comprising several dozen species, as well as in several Cretaceous forms. On the other hand, the Paleozoic shells otherwise identifiable with Nucula lack the denticulations on the interior along the ventral margin. We have not discovered a single specimen from the Ordovician, Silurian, Devonian or Mississippian which possesses the denticulate ventral margin, except the little *Nucula shumardiana* Hall, from the Mississippian Spergen limestone of Indiana. Doubtful appearances of a crenulate margin in this tiny species have been observed on some specimens from Spergen Hill. This species appears, however, even externally, to be more nearly related to the recent *Nucula pernula*[2] than to the other Paleozoic Nuculas. The persistent absence of the denticulate margin in the early and frequently large Nuculas and its persistent development in the Recent Nuculas furnish a ready and easy distinction. The non-denticulate and earlier form is here designated Nuculoidea, from its resemblance to Nucula.

[2] "*Arca*" *pernula* Müller, type of *Nuculana* Link, 1807, family Nuculanidae.

In view of these remarks it occasioned considerable surprise during the course of the preparation of the present specimen to find that the inner margins were not smooth, as claimed by Williams and Breger, but were actually marked by the presence of long, closely parallel, microscopic striations that gave a distinctly pectinate appearance under the microscope. These striations are so fine as to be observable with difficulty without magnification and would probably be quickly lost through weathering on any natural internal mold, such as was available to Williams and Breger. The striations are present on the anterior, ventral, and posterior internal margins of the valves; they are separated by interspaces approximately twice the width of the striation, and the area of the valve margin marked by their presence is approximately 15 times the width of the interspaces.

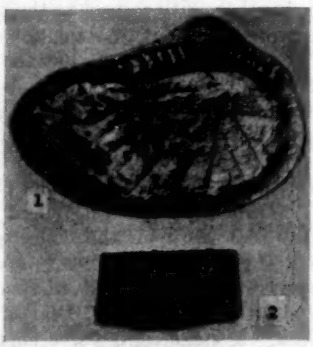

FIG. 1.—View of the interior of specimen of *Nuculoidea opima* (Hall) from Pratts Falls, N. Y., × 2. FIG. 2.—Enlarged view of portion of anterior ventral margin outlined in Fig. 1, showing the nature of the marginal denticulations or pectinations, × 7½.

The occurrence of this structure was so unexpected that a second preparation was made from a bivalved specimen from Pompey, N. Y., which was enclosed in a brownish-buff, calcareous, shaly matrix. The hinge structures were not so well preserved, but the characteristic internal striations were equally developed. This would seem to confirm their presence as a definite character of the species, and not as a result of the vagaries of preservation of the form.

It is difficult to assess the significance of this character. The presence or absence of denticulations on the inner margins of the valves has been used by many authors as a

means of subdividing genera of the Nuculidae. The first to do so appears to have been Defrance, in 1825, the latest seems to have been Schenck (1934), who proposes the following classification:

(A) Forms with denticulate ventral margins:
  (1) *Nucula* Lamarck, 1799
  (2) *Pronucula* Hedley, 1902
  (3) *Pectinucula* Quenstedt, 1930
  (4) *Linucula* Marwick, 1931
(B) Forms with smooth inner ventral margins:
  (5) *Nuculoma* Cossmann, 1907
  (6) *Nuculopsis* Girty, 1911
  (7) *Nuculoidea* Williams and Breger, 1916
  (8) "*Nuculopsis*" Woodring, 1925
  (9) *Leionucula* Quenstedt, 1930
  (10) *Palaeonucula* Quenstedt, 1930
  (11) *Ennucula* Iredale, 1931
  (12) *Brevinucula* Theile, 1934
(C) Forms with divaricate sculpture:
  (13) *Acila* H. and A. Adams, 1858
  (14) *Truncacila* Schenck, *in* Grant and Gale, 1931
(D) Systematic position uncertain:
  (15) *Deminucula* Iredale, 1931
  (16) *Protonucula* Cotton, 1930
  (17) *Nucula tuberculata* Gabb, 1873

Cox (1940, pp. 10–11) has taken exception to the use of denticulations, stating:

> One difference between the Jurassic and earlier forms and the Recent genotype of *Nucula* lies in the absence of the internal marginal denticulations which characterize that species. Such denticulations are not, however, present in all the Recent species, some of which have completely smooth margins, while others (*N. obliqua* Lamarck, *N. expansa* Reeve, *N. superba* Hedley), smooth margined to the naked eye, may be seen under a lens to have very finely denticulate margins. The denticulation of the margins appears, therefore, to be a matter of degree and not a clear basis for generic separation. The complete absence of denticulations in the earlier fossil forms is, however, significant.

The significance of this argument is somewhat impaired, however, when it is realized that all three of the species mentioned specifically are representatives of *Ennucula* Iredale, 1931, the first, "*Nucula*" *obliqua* Lamarck, being the type of the subgenus. This group was differentiated from *Nucula* s.s., in part on hinge characters, as well as on the supposed absence of denticulations. It would seem, however, that on the basis of these microscopic denticulations, the subgenus *Ennucula* must be transferred from Schenck's group B (above) to his group A. The final sentence in the quotation given above serves, however, to emphasize the unique nature of the marginal pectination observed in *Nuculoidea opima*, and together with the nature of the hinge, and especially of the chondrophore, to stress the generic entity of *Nuculoidea*. This genus, too, must be removed from Schenck's group B, but in view of the difference between the pectinate structure developed by the striations, and the typical denticulate structure present in *Nucula* s.s., it would seem to require the recognition of a separate group for its reception.

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BOTANY.—Muhlenbergia minutissima (*Steud.*) *Swallen and its allies.*[1] Charlotte Goodding Reeder,[2] Osborn Botanical Laboratory, Yale University. (Communicated by Jason R. Swallen.)

Critical study of the annual species of *Muhlenbergia* has revealed the need for several changes in synonymy, as well as the desirability of describing a new species in this large and complex genus. These changes are presented in this paper.

Recently Swallen published the results of his study of the "Awnless Annual Species of *Muhlenbergia*" (Contr. U. S. Nat. Herb. **29:** 203–208. 1947). From the material that in the North American Flora (**17**(7): 485–486. 1937) was treated as only four species (of

[1] Received July 28, 1949.

[2] I am indebted to Dr. Frank Gould, of the University of Arizona Herbarium (ARIZ), and to Dr. H. A. Gleason, head curator of the New York Botanical Garden (NY), who kindly lent material

Sporobolus), Swallen has recognized eight species, two of which he described as new. In so doing, he segregated *Muhlenbergia minutissima* (Steud.) Swallen as a distinct species, adding at the end the remark (op. cit., p. 208): "Typically, the lemma is quite awnless, but occasionally there is a very short awn or mucro, indicating a relationship with *M. texana* and a transition from the awnless to the awned species of *Muhlenbergia*." Since *M. texana* Buckl. was not included in his discussion or key, attempts to find means of distinguishing it from *M. minutissima* led to a detailed study of it and its close allies.

With his brief description of *Muhlenbergia texana*, Buckley (Proc. Acad. Nat. Sci. Philadelphia 1862: 90. 1862) cited no specimen, simply stating: "Northern Texas.. May." Gray's commentary on Buckley's paper (Proc. Acad. Nat. Sci. Philadelphia 1862: 334. 1862) indicates that no specimen bearing this name came to Harvard University or to the Academy of Natural Sciences in Philadelphia, although one at the latter herbarium marked "*Agrostis barbatis* Buckl." seems to fit the description, and as Gray remarked: "This is a form of Sporobolus ramulosus." An examination of the material in the Philadelphia Academy[3] reveals that the above-mentioned specimen bears no data as to collector or locality of collection. It is evident from Buckley's paper itself, and particularly from Gray's critique that many of Buckley's species are based on Charles Wright numbers, and the present case is probably no exception. Swallen states[4] that the specimen of *Wright 736* (collected in expedition from western Texas to El Paso, N. Mex., May–Oct. 1849) at the U. S. National Herbarium appears to be identical with the sheet of *Agrostis barbatis* Buckl. in Philadelphia and may well represent the same collection. Bush, who attempted to locate specimens of *M. texana*, states (Amer. Midl. Nat. **7:** 41. 1921): "Hitchcock writes me that Wright's no. 736 is the only specimen [of *M. texana*] in the U. S. National Herbarium from the United States." Buckley's mention of "May" as the time of collection seems further evidence that his description was based upon this Wright specimen. Since the time of collection on that sheet is given as "May–October 1849," Buckley could easily have copied only the "May." It seems significant that the majority of the specimens examined were collected from August to October, and had Buckley himself been the collector he would hardly have made such an error. It seems safe, therefore, to consider that *Wright 736* is the plant upon which Buckley based his description. When that specimen was critically examined it was found to fit unmistakably into *M. minutissima* (Steud.) Swallen, and *M. texana* Buckl. becomes accordingly a synonym of that species. The revised synonymy is as follows:

Muhlenbergia minutissima (Steud.) Swallen, Contr. U. S. Nat. Herb. **29:** 207. 1947.

Agrostis minutissima Steud. Syn. Pl. Glum. **1:** 171. 1854.

Muhlenbergia texana Buckl. Proc. Acad. Nat. Sci. Philadelphia 1862: 91. 1862.

Muhlenbergia Buckleyana Scribn. Contr. U. S. Nat. Herb. **1:** 56. 1890. (Based on *M. texana* Buckl. Name changed because supposed to be a later homonym of *M. texana* Thurb., 1874.)

Podosaemum texanum (Buckl.) Bush, Amer. Midl. Nat. **7:** 41. 1921.

Sporobolus minutissima (Steud.) Hitchc. Proc. Biol. Soc. Washington **41:** 161. 1928.

For the citation of representative specimens see Swallen (Contr. U. S. Nat. Herb. **29:** 207–208. 1947).

This and the following species are closely related and, to those not thoroughly familiar with the group, the distinctions may seem too slight for specific designation. The most useful characters for differentiating them seem to be the longer spreading pedicels and the slightly shorter lemmas with distinctly shorter awns in *Muhlenbergia minutissima*. Although the lemmas rarely have awns 1 mm or more in length, for the most part they are either lacking or not over 0.5 mm

for this study. Specimens have also been examined in the U. S. National Herbarium (US) through the courtesy of Jason R. Swallen, and in the Chicago Natural History Museum (F) through the kindness of Paul C Standley. Specimens in the Herbarium of Yale University (YU) have also been studied. I am especially indebted to my husband, Dr. John R. Reeder, for his aid in the preparation of the manuscript.

[3] I am indebted to Jason R. Swallen for examining and verifying the material in Philadelphia, as well as for supplying notes on the specimens there.

[4] In personal communication.

long. Moreover, the long-awned spikelets seem to occur at the tips of the panicle branches, while the lower spikelets are awnless or short-awned.

There remained specimens, largely from Mexico, with only a few from Arizona and New Mexico, which did not fit the description of *Muhlenbergia minutissima* and which had heretofore been referred to *M. texana* Buckl. Since no name was found to be available, a new one is here proposed:

Muhlenbergia eludens C. Reeder, sp. nov.

Annua 15–40 cm alta; culmis erectis vel adscendentibus 2–4-nodosis, gracilibus teretibus simplicibus vel e nodis inferioribus ramosis, strigosis saltem infra nodis; vaginis carinatis scaberulis vel plus minusve puberulis quam internodis plerumque brevioribus; ligula membranacea erosa vel lacerata, 1.5–2.5 mm longa; laminis plerumque erectis anguste linearibus involutis saltem in sicco, 1–10 (plerumque 2–5) cm longis, circiter 1 mm latis, supra pubescentibus, subtus scabris vel plus minusve puberulis; paniculis patentibus anguste pyramidalibus saltem 2/3 altitudo herbae aequalibus ad 7 cm latis, axi scaberula vel substrigosa, ramis capillaribus scabris adscendentibus vel late patentibus, inferioribus plerumque 2.5–5 cm longis, ramis secundariis paucis circiter 0.5 cm longis; pedicellis gracilibus adpressis scabris circiter 0.5–2.0 mm longis, infra spiculam dilatis; glumis subaequalibus (gluma prima paullo breviore), 1-nervis, acutis, acuminatis vel attenuatis, 1–2 mm longis pubescentibus saltem apicem versus; lemmate subhyalino (arista 1.5–3.5 mm longa exclusa) circiter 2–2.5 mm longo, 3-nervo, apice bifido, marginibus et nervo centrali saltem basim versus sericeo, callo minute sericeo; palea glabra lemmati subaequali; antheris circiter 0.5–0.6 mm longis; fructibus maturis circiter 1.5 mm longis.

UNITED STATES: New Mexico: Datil Forest, *Koogler K-1* (*Forest Service 50696*) (US). Arizona: Cochise County: Rucker Canyon, Chiricahua Mountains, *Gould & Haskell 4589* (ARIZ), Reef Mine, Huachuca Mountains, *Darrow, Gould, Phillips & Pultz 1490* (ARIZ).

MEXICO: Chihuahua: Sánchez, *Hitchcock 7664½* (US); Miñaca, in bed of rocky run, alt. about 2,100 meters, *Hitchcock 7768* (ARIZ, US, YU, Type) October 13, 1910; near Chihuahua, *Pringle 399* (F, NY, US) (wet ledges of rocky hills), *400* (F, NY, US) (on gravel bars of streams); Sierra Madre, *Pringle 3052* (NY, US), (*sine coll. no.*) (US); Río Negro, *Le Sueur 0196* (US); Noragachi, *Palmer 3d* in 1885 (US). Durango: Sandia Station, alt. about 2,000 meters, *Pringle 13629* (US).

The new species resembles *Muhlenbergia minutissima* in having pubescent glumes and an open panicle, but that species differs in having longer capillary pedicels (2–4 mm long) and smaller spikelets (1–1.7 mm long), in which the glumes are slightly shorter. The lemma is shorter and bears an awn only 0.1–0.5 (rarely to 1.0) mm long.

Muhlenbergia eludens is also closely related to *M. flavida* Vasey, in which the glumes are aristate

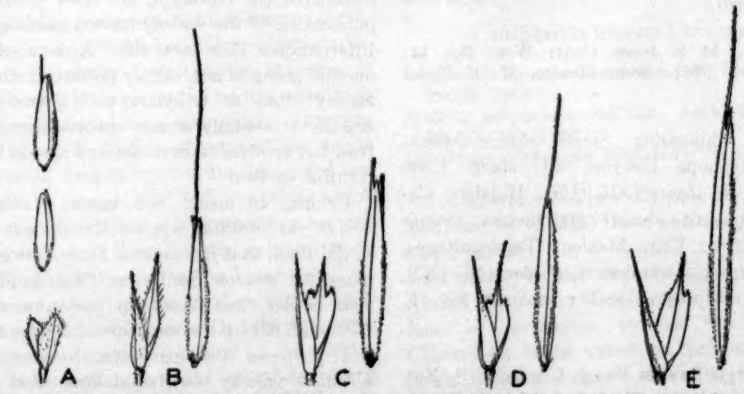


FIG. 1.—Spikelets of *Muhlenbergia minutissima* and its allies: A, *M. minutissima*, awnless floret and glumes (*Fendler 986*) and awned floret (*Wright 736*); B, *M. eludens* (type); C, *M. schmitzii* (*Pringle 8951*); D, *M. flavida* (*Palmer 645*); E, *M. strictior* (*Pringle 1418*). All × 10.

but not uncommonly also with a short tooth on one or both sides of the midnerve. The glumes are, moreover, glabrous or scabrous near the apex, rather than pubescent, and the lemmas tend to be longer (2.5–3 mm). A further difference is seen in the inflorescence which comprises less than half the total height of the plant.

Since *Muhlenbergia eludens* has several close allies, the following key and notes are included as an aid in the identification of members of this complex:

1*a*. Glumes glabrous or scabrous, at least near the apex.
  2*a*. Plants 50–75 cm tall; lemma mucronate or short-awned (the awn not more than 0.5 mm); anthers 1–1.5 mm long. *M. schmitzii*
  2*b*. Plants commonly not over 35 cm tall; lemma with an awn 1.5–2 mm long (rarely longer); anthers 0.5–0.8 mm long.
    3*a*. Lemma 2.5–3 mm long; panicle open (1–4 cm. wide), the branches ascending. *M. flavida*
    3*b*. Lemma mostly 3.5–4 mm long; panicle mostly contracted (1 cm or less wide), the branches appressed. *M. strictior*
1*b*. Glumes pubescent to short pilose.
  4*a*. Pedicels 2–4 mm long, spreading; lemma 1–1.7 mm long, awnless or with an awn 0.1–1.0 (mostly 0.1–0.5) mm long. *M. minutissima*
  4*b*. Pedicels mostly not over 2 mm long, appressed; lemma 2–2.5 mm long, with an awn about 1.5–3.5 mm long. *M. eludens*

Muhlenbergia schmitzii Hack., Ann. Nat. Hofmus. Wien **17:** 255. 1902. (Type from Mexico, *Schmitz 380*.)

M. Diehlii M. E. Jones, Contr. West. Bot. **14:** 13. 1912. (Type from Mexico, *M. E. Jones 7316*.)

Mexico: Chihuahua: Sierra Madre Mountains, Guayanopa Canyon, alt. about 1,500 meters, *M. E. Jones 7316* (US). Hidalgo: Canales Station, alt. about 1,800 meters, *Pringle 8951* (F, NY, US). Mexico: Temascaltepec, Comunidad, alt. 2,460 meters, *Hinton 1565* (NY, US). Without precise locality, *Schmitz 380* (F, US).

Muhlenbergia flavida Vasey, Contr. U. S. Nat. Herb. **1:** 282. 1893. (Type from Mexico, *Palmer 645* in 1886.)

Mexico: Jalisco: Río Blanco, *Palmer 645* in 1886 (US, YU); ravines near Guadalajara, alt. about 1,500 meters, *Pringle 11749* (F, US).

Muhlenbergia strictior Scribn. ex Beal, Grasses N. Amer. **2:** 263. 1896. (Type from Mexico, *Pringle 1418*).

M. flavida Vasey var. *strictior* (Scribn. ex Beal) Scribn. ex Urbina, Cat. Pl. Mex. 394. 1897.
M. madrensis M. E. Jones, Contr. West. Bot. **14:** 12. 1912. (Type from Mexico, *M. E. Jones 7315*.)

Mexico: Chihuahua: Sierra Madre, *Pringle 1418* (F, NY, US), *1699* (US), *3034* (F, NY, US); Round Valley, alt. about 2,100 meters, *M. E. Jones 7315* (US); Sánchez, *Hitchcock 7673* (US); Miñaca, alt. about 2,100 meters, *Hitchcock 7765* (ARIZ, NY, US, YU). Durango: Sierra Madre Occidental, El Salto, Pineland Canyon, alt. 2,500–2,530 meters, *Pennell 18513* (US); Sandia Station, alt. 2,000 meters, *Pringle 13630* (US). Federal District: Valley of Mexico, *Pringle in 1903* (US).

Presumably the grasses that Pringle collected in Mexico in 1887–88 were sent to Scribner for determination. Both the specimen Beal cited (*Pringle 1418*, Sept. 1887) and the one cited by Urbina (*Pringle 3034*, Oct. 1888) bore the printed herbarium name "*Muhlenbergia flavida* Vasey var. *strictior* Scribner," which was, however, never published by Scribner. These two specimens have been examined by the writer and are certainly conspecific.

Beal lists under *Muhlenbergia strictior:* "*M. flavida* var. *strictior* Scribn. ined." This cannot be considered the basonym, nor does it constitute publication of the variety since according to the International Rule (art. 40): "A name of a taxonomic group is not validly published when it is merely cited as a synonym." Therefore, *M. strictior* is actually a new species described by Beal but credited to Scribner and should be cited "Scribn. ex Beal."

Urbina, in using the name *Muhlenbergia flavida* var. *strictior*, apparently did not realize, as did Beal, that it was ined. Since, however, the name *M. strictior* Scribn. ex Beal, published a year earlier, was based on the same material (although not on the same specimen) for all practical purposes it seems proper to consider that Urbina's variety was based upon that species. The correct citation for the variety is, then: *M. flavida* Vasey var. *strictior* (Scribn. ex Beal) Scribn. ex Urbina.

Hitchcock states (North American Flora 17(6): 438. 1935) in regard to *Muhlenbergia flavida* var. *strictior*: "Differing [from the species] only in the contracted panicle." Examination of the types and other available material reveals, however, that there are other differences. Although the glumes are 1.5–2 mm long in both cases, the relationship of glumes to floret is not the same due to a difference in the floret length, which is about 1 mm longer in *M. strictior*. Whereas in *M. flavida* the glumes are about two-thirds as long as the floret, in *M. strictior* they are scarcely half as long. In view of these differences, which appear to be as significant as those separating other species in the genus, it seems advisable to reinstate the name which was used by Beal.

Although *Pringle 3034* is unusual in having the panicle branches somewhat stiffly spreading, they are not slender and lax as are those of *M. flavida*. In all other characters it agrees well with the type of *M. strictior*.

ENTOMOLOGY.—*Notes on some West Indian Chrysomelidae.*[1] DORIS H. BLAKE, Arlington, Va.

This paper deals with six new species of Chrysomelidae from the West Indies that have come to the writer's attention as well as notes on certain changes in the generic status of two other described species.

Alethaxius bruneri, n. sp.

Fig. 6

About 3 mm in length, oblong oval, dark lustrous green with reddish antennae, mouthparts, and tarsi, the tibiae a little darker and the femora tending to be piceous; one male, possibly immature, paler in color with reddish elytra having a green luster, the legs and body beneath reddish; all femora toothed, female with nodules on sides of elytra; thorax densely and finely punctate, not quite twice as wide as long, with two lateral teeth.

Head shining green with reddish-brown mouthparts, upper part with scattered punctures becoming denser lower down between the eyes; in one specimen a little pit on the vertex, sometimes a median impressed line; eyes entire. Antennae reddish brown or darker, about half the length of the beetle, first two joints swollen, third and fourth not so long as fifth, last five joints longer and thicker. Prothorax not quite twice as wide as long, with two lateral teeth, a broad tooth anteriorly and a smaller one at basal angle; except around the margin the surface very densely punctate. Elytra of female with tubercles along sides from the prominent humeri to the middle; in male these lacking; a slight lateral depression below the intrahumeral sulcus; basal third densely punctate, the punctures then becoming sparser and irregularly 8-striate. Body beneath dark brown or piceous, finely alutaceous and with fine white pubescence. All femora toothed; tending to be dark brown or piceous in color, the tibiae and tarsi paler. Length 2.7–3.2 mm; width 1.6–1.8 mm.

Type male and 3 paratypes, U.S.N.M. no. 59313.

Type locality.—Palma Mocha to Pico Joaquin, Sierra Maestra, Cuba, elevation 3,500–5,300 feet, collected on May 18, 1948, by J. Acuña and J. Ferrás.

Other localities.—Sierra Maestra, 3,600–3,900 feet, collected on May 15–16, 1948, by J. Ferrás.

Remarks.—This is smaller and greener and less densely punctate than the coppery colored *A. turquensis* Blake and has a wider prothorax and darker femora.

Blepharida irrorata Chevrolat

Blepharida irrorata Chevrolat, Rev. Mag. Zool. (2) **16**:182. 1864.
Haltica adspersula Suffrian, Arch. für Naturg. **38** (1): 185. 1868.
Disonycha adspersula (Suffrian), Junk Catalogue.

S. C. Bruner has recently sent me a specimen identified by Manuel Barro as *Disonycha adspersula* (Suffrian). On comparing it with Suffrian's description, I find that it agrees with that species. However, it is simply the dark color form of *Blepharida irrorata* Chevrolat, and Chevrolat's name antedates Suffrian's by four years. Suffrian assigned this color form simply to *group b* under *Haltica*, with no indication that he believed it to be a *Disonycha*.

[1] Received July 27, 1949.

Aphthona schwarzi, n. sp.

Fig. 5

About 1.5 mm in length, oblong oval, yellowish or reddish brown with a faint brownish band across the middle of the elytra and a slight darkening along the base, these markings not visible in all specimens; antennae pale with joints 8–10 dark.

Head shining and smooth with the usual line from antennal socket to upper eye and a small fovea near eye, frontal tubercles faintly indicated, interantennal area moderately broad but not produced at all. Antennae pale with joints 8–10 black, joints 2, 3, and 4 subequal and shorter than fifth. Prothorax wider than long with truncate anterior angles and arcuate sides; shining and distinctly punctate. Elytra broad, shining, distinctly striate punctate throughout, with a deeper reddish brown band across the middle and a faint shading along the base, these markings not apparent in all specimens. Body beneath shining and entirely pale, first tarsal joint of hind legs moderately long. Length 1.3–1.4 mm; width 0.8 mm.

Type male and 4 paratypes U.S.N.M. no. 59316.

Type locality.—Cayamas, Santa Clara Province, Cuba, collected on June 2 by E. A. Schwarz.

Remarks.—This tiny species also belongs to the group of pale brown species related to *insolita* Melsheimer, which Crotch assigned to the genus *Ceratultica*. It differs from *A. fraterna* and *A. elachia* Blake by having joints 8–10 black, the former having joints 6–9 black and *elachia* having joints 8–9 black. It is also unlike them in having a more or less distinct band across the elytra.

Aphthona nana, n. sp.

Fig. 3

About 1.3 mm in length, oblong oval, shining yellowish or reddish brown with slightly darker antennae; prothorax very faintly and finely punctate, elytral striae rather indistinct.

Head shining, very finely and indistinctly punctate, frontal tubercles outlined by a fine line across with two or more punctures grouped about the line at the upper edge of eye; interantennal area rather wide and somewhat produced into a carina. Antennae a little darker than rest of body, second, third, and fourth joints subequal. Prothorax a little wider than long, the sides only feebly arcuate with an oblique anterior angle and a tiny basal tooth; lustrous, very faintly and finely punctate. Elytra a little wider than prothorax with fine striate punctation becoming very faint at sides and apex. Body beneath and legs entirely pale and shining. First joint of hind tarsi long. Length 1.3 mm; width 0.6 mm.

Type male and 1 paratype, U.S.N.M. no. 59315.

Type locality.—Caimito, Habana Province, Cuba, collected on August 23, 1917, by Harold Morrison.

Other locality.—Baraguá, Cuba, collected on October 14, 1927, by L. C. Scaramuzza.

Remarks.—Although smaller and more slender than any of the other species of the group allied to *insolita* Melsheimer, this species plainly belongs with them.

Aphthona inornata, n. sp.

Fig. 1

About 2 mm in length, oblong oval, shining yellowish or reddish brown with the distal joints of the antennae a little deeper brown; prothorax finely and densely punctate, the striate punctures of the elytra faint on lower sides and apex.

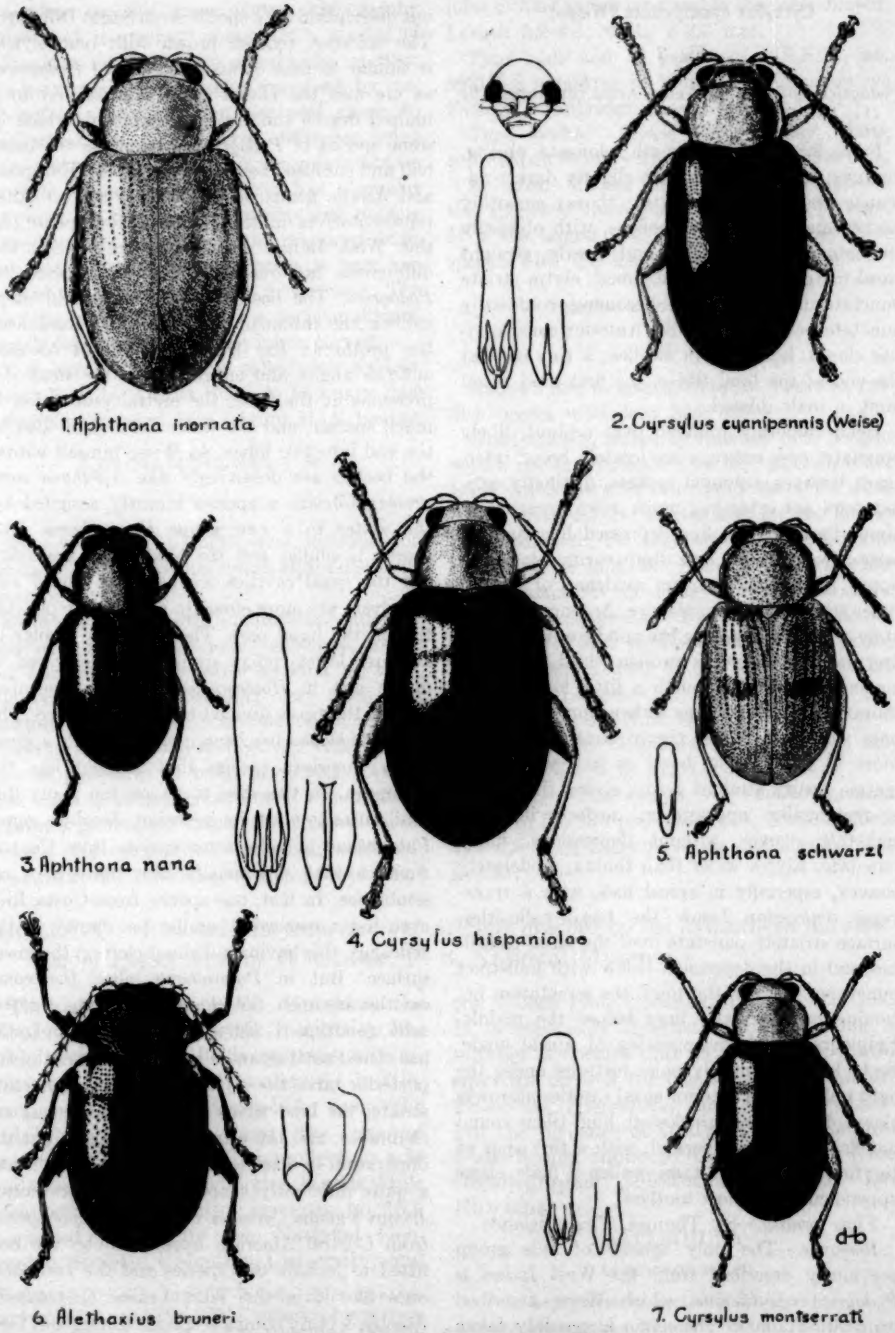
Head polished, impunctate except for one or two punctures near the top of the eye close to the oblique line running up from the antennal socket to upper margin of eye; frontal tubercles indistinct, interantennal area broad and somewhat produced. Antennae with pale basal four joints and darker distal joints, third joint shorter than fourth. Prothorax wider than long, finely and densely punctate; shining, smoothly convex, with arcuate sides. Elytra broader than prothorax, smoothly convex, shining, the striate punctures faint on the sides below the middle and towards the apex. Body beneath entirely pale, shining, very finely pubescent; legs entirely pale, the first joint of hind tarsi rather long. Length 1.8 mm; width 1 mm.

Type female, U.S.N.M. no. 59314.

Type locality.—Río Piedras, Puerto Rico, collected on July 31, 1914, by T. H. Jones.

Other locality.—Anasco District, Puerto Rico, collected on July 3, 1917, by Harold Morrison.

Remarks.—This also belongs to the *Ceratultica* group and is closely related to *insolita* Melsheimer from North America and *A. fraterna* and *elachia* Blake from Haiti, but, unlike them, it does not have the antennae in part black.



FIGS. 1–7.—West Indian Chrysomelidae.

Cyrsylus cyanipennis (Weise)

Fig. 2

Podagrica cyanipennis Weise, Arch. für Naturg. 51 (1): 165. 1885.

From 2.8–4 mm in length, elongate oblong, lustrous, reddish brown with slightly darker antennae and deep blue elytra; thorax smoothly convex and without depressions, with obliquely truncate anterior angles and nearly straight basal margin, distinctly margined; elytra striate punctate in basal third becoming confusedly punctate before the middle. Anterior coxal cavities closed, hind femora swollen, a tiny spur at the end of the hind tibiae, the first hind tarsal joint in male dilated.

Head smoothly rounded over occiput, finely punctate; eyes entire, a moderately broad interspace between antennal sockets, distinctly carinate and not extending much down lower front, above limited by a fine depressed line running across front to eye and disappearing along the upper margin of eye; no evidence of frontal tubercles or fovea near the eye. Antennae moderately stout, not reaching the middle of the elytra, first and second joints swollen, third not much longer than second, fourth a little longer. Prothorax not quite twice as wide as long with sides only slightly arcuate, nearly straight, a small tooth at basal angle; basal as well as anterior margin nearly straight across giving the thorax a rectangular appearance; surface lustrous, smoothly convex without depressions, finely punctate. Elytra wider than thorax, moderately convex, especially in apical half, with a transverse depression below the basal callosities; surface striately punctate over the basal callosities and in the depression below with indistinct punctures between the rows, the punctation becoming confused and finer before the middle. Epipleura broad, disappearing at apical angle. Body beneath entirely pale; lustrous under the light pubescence; anterior coxal cavities narrowly closed; hind femora thickened, hind tibiae round not flattened or channelled, with a tiny spur at tip; first joint of hind tarsi swollen in male, claws appendiculate, almost toothed.

Type locality.—St. Thomas, Virgin Islands.

Remarks.—The only species of this group previously described from the West Indies is *Podagrica cyanipennis*, which Weise described from St. Thomas. The name is possibly taken from DeJean's Catalogue, where it is used without description for a species from Santo Domingo. The coloring, reddish brown with blue elytra, is similar to that of many species of *Podagrica*, as are also the closed coxal cavities and to a limited degree the elytral punctation, which in some species of *Podagrica* is striate in the basal half and confused below. *Podagrica* is a European and Asiatic genus of which there are no other representatives in the Western Hemisphere. In this West Indian group of three species the differences far outweigh the resemblances to *Podagrica*. The beetles are narrower and more convex, the antennae are not so much thickened, the prothorax has truncate and not toothed anterior angles and entirely lacks the small depressions at the base, the elytral punctation is much sparser, and the tibiae are not divided at the end into two lobes. As Weise himself wrote, the beetles are deceivingly like *Aphthona compressa* Suffrian, a species recently assigned by the writer to a new genus *Homoschema*. The thorax is similar and the hind tibiae are alike, but the coxal cavities are narrowly closed and the elytra are more elongate with striate punctation in the basal part. The aedeagus, similar in all three West Indian species here described, is unlike any in *Homoschema* and most peculiar in that the tip is divided for some distance. The genus *Aphthona* has been used to include a great many American species that are not like the European. In this case there are too many dissimilarities to allow its inclusion. Jacoby's genus *Palaeothona* includes some species from Central America that superficially bear more of a resemblance. In fact, one species from Costa Rica even has a somewhat similar peculiarity of the aedeagus, this having a distinct cleft on the lower surface. But in *Palaeothona*, also, the coxal cavities are open, not closed. The genus *Aphthonella*, genotype *A. blamoensis* Jacoby from India, has closed cavities and a long first segment of the posterior tarsi, the elytra are regularly punctate striate, the hind tibiae (unlike this species) are channeled, and the claws appendiculate, but the illustration in *The fauna of British India* shows a quite differently shaped head and prothorax. Jacoby's genus *Cyrsylus*, composed of five species from Central America, appears to be the best fitted to include this species and the two other ones like it in the West Indies. *C. recticollis* Jacoby, a fairly common species throughout Central America, is entirely brown, but *C. crassi-*

cornis has metallic green elytra, and Jacoby writes that it strongly resembles a species of *Palaeothona* except for the closed coxal cavities. The only species of *Cyrsylus* examined by me, *C. recticollis*, is similar in size and shape to *cyanipennis*, the only marked difference being in the elytral punctation which is regularly striate punctate throughout. The head has a similar sculpture, the thorax is rectangular with oblique anterior angles, and a straight margined base. The first joint of the hind tarsus is long and appears to be likewise dilated in the male. The aedeagus, while not having the peculiar divided apex, is long, slender and not much curved.

This species has also been collected at Fajario, Puerto Rico, by August Busck in February 1899 and at Christiansted, St. Croix, by H. A. Beatty.

Cyrsylus hispaniolae, n. sp.

Fig. 4

From 4–4.5 mm in length, oval, lustrous, yellow-brown with deep blue elytra, elytra distinctly punctate.

Head shining, smooth, impunctate. Antennae with second and third joints subequal, fourth and remaining nearly twice as long as third, pale yellow-brown. Prothorax very finely and indistinctly punctate, about one-fourth as long as elytra. Elytra broad and convex with distinct rows of punctures in basal part, and between these rows of coarser punctures a row of finer, indistinct punctures; below the transverse depression the punctation becoming confused; occasionally the rows somewhat impressed. First joint of hind tarsus long and in the male dilated. Length 3.9–4.5; width 2–2.3 mm.

Type male and 12 paratypes U.S.N.M. no. 59317, 2 paratypes in Museum of Comparative Zoology, Cambridge, Mass.

Type locality.—Froide River Valley, Haiti, collected on January 28, 1925, by W. A. Hoffman.

Remarks.—Except for the points noted above, this species is much like *C. cyanipennis* (Weise). It is the largest and most robust of the three species with the most distinct punctation.

Cyrsylus montserrati, n. sp.

Fig. 7

About 3 mm in length, elongate, lustrous, reddish brown with deep blue elytra.

Head shining, smoothly rounded over occiput with a few fine punctures on top, paler in lower front. Antennae with third joint about the same length as second and shorter than fourth. Thorax finely punctate, the sides nearly straight, about one-fourth as long as elytra. Elytra with fine striate punctures becoming confused behind the transverse impression. Undersurface lustrous. First joint of hind tarsi not quite as long as the rest together, dilated in the male. Length 2.9 mm; width 1.4 mm.

Type male, U.S.N.M. no. 59318.

Type locality.—Montserrat, West Indies, collected on March 18 by H. G. Hubbard.

Remarks.—This species, very similar in most points to the two preceding ones, is the smallest and the most finely punctate and also is more slender.

ZOOLOGY.—*Echinoderms from the mid-Atlantic dredged by the* Atlantis *in the summer of 1948.*[1] AUSTIN H. CLARK, U. S. National Museum.

Through Dr. Louis W. Hutchins the Woods Hole Oceanographic Institution has submitted to me for study an unusually interesting collection of sea-stars, brittle-stars, sea-urchins, and sea-lilies from the mid-Atlantic, largely from the general vicinity of the Azores. This collection was made by the *Atlantis* of the Woods Hole Oceanographic Institution on cruise no. 152, sponsored jointly by the National Geographic Society, Columbia University, and the Woods Hole Oceanographic Institution. It is especially interesting in including a number of species that have not been found since the days of the *Challenger*, *Travailleur*, *Talisman*, *Hirondelle*, and *Princesse-Alice*. For the pleasure of studying this collection I am deeply indebted to the Woods Hole Oceanographic Institution and to Dr. Hutchins.

[1] Contribution from the Woods Hole Oceanographic Institution No. 471. Published by permission of the Secretary of the Smithsonian Institution. Received April 25, 1949.

ASTEROIDEA

ASTROPECTINIDAE

Leptychaster arcticus (M. Sars)

Astropecten arcticus M. Sars, Reise i Lofoten og Finmarken, Nyt Mag. for Naturvid. **6**:161. 1851.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 53′ W.); 85 fathoms; July 31, 1948. Thirteen specimens.

Note.—In all the specimens R = about 30 mm.

Plutonaster notatus Sladen

Plutonaster notatus Sladen, *Challenger* Reports, Zoology, **30** (pt. 51): 97, pl. 14, figs. 6, 7, pl. 15, figs. 5, 6. 1889.

Locality.—*Atlantis* cruise 152, station 28; southwest of the Azores (lat. 34° 50′ N., long. 39° 20′ W.); 1,770 fathoms; August 30, 1948. Three specimens.

Notes.—One of the specimens measures R = 25 mm., r = 8 mm.; in the other two R = 22 mm., r = 8 mm. In one specimen many and in the others a few of the papillae on the abactinal surface have 2 to 4 (usually 3) of the central spines enlarged and swollen, forming a pedicellaria. Two of the specimens have a few similar pedicellariae on the actinal surface.

Dytaster biserialis Sladen

Dytaster biserialis Sladen, *Challenger* Reports, Zoology, **30** (pt. 51): 77, pl. 10, figs. 3, 4, pl. 13, figs. 3, 4. 1889.

Locality.—*Atlantis* cruise 152, station 8; west of Newfoundland and south of Greenland (lat. 47° 10′ N., long. 36° 00′ W.); 2,300 fathoms; August 2, 1948. One specimen.

Notes.—In this specimen R = 43 mm., r = 9 mm.; there are 28 marginals.

Dytaster mollis (E. Perrier)

Crenaster mollis E. Perrier, Expéditions scientifiques du *Travailleur* et du *Talisman* pendant les années 1880, 1881, 1882, 1883, Échinodermes: 310, pl. 18, figs. 3, a, b. 1894.

Locality.—*Atlantis* cruise 152, station 20; west of San Miguel, Azores (lat. 37° 50′ 30″ N., long. 26° 00′ W.); 1,400 fathoms; August 18, 1948. One specimen.

Notes.—There seems to be no doubt that this specimen represents Perrier's *Crenaster mollis*, which was described from a single individual dredged southwest of Terceira, Azores (lat. 38° 38′ N., long. 27° 26′ W.), in 2,995 meters. It does not quite agree in some respects with Perrier's description, which differs slightly from his figures, so that it appears desirable to describe it in detail.

Description.—R = 40 mm., r = 9 mm. The form is stellate with the angles of the star produced into long narrow arms and the interbrachial arcs broadly and regularly rounded.

The plates of the abactinal surface are small, 4 or 5 to a millimeter in the central portion of the disk and along the middle of the rays, gradually becoming larger toward the borders of the interradial areas and rather abruptly larger in the two rows adjacent to the superomarginals, both on the disk and on the arms. The plates are very delicate, thin and glassy, subcircular or polygonal, and where there are interstices between them these are bridged by thin filmy scale-like plates, the whole forming a continuous mosaic. The surface of each plate, except for a narrow glassy rim, is abruptly raised into a stout opaque cylindrical tubercle with a broadly rounded summit, these tubercles being mostly higher than thick; the large tubercles along the interradial margins of the disk are more or less capitate. Each tubercle bears on its summit a group of commonly 6–9 spines arranged in a circle, with or without a central spine. These spines are usually somewhat longer than the tubercle is high, and are slightly flaring and thorny in the distal half. The madreporite is large, situated near the interradial border and almost in contact with the superomarginals. It is surrounded by a ring of about 15 somewhat enlarged spine-bearing tubercles, and carries 4 much enlarged spine-bearing tubercles on its surface.

As viewed from the side the marginals of the two series are equal in size and similar, and the superomarginals lie directly over the inferomarginals so that the line separating them, and the vertical lines separating the pairs, are straight and at right angles to each other. The marginals decrease slowly and regularly in size from the interbrachial arcs outward to the tips of the rays. In the interbrachial arcs the marginals are square, but they soon become about half again as long as broad, in the outer third of the rays slowly decreasing in length and becoming square at some distance from the tips. The inferomarginals encroach more on the actinal than the superomarginals do on the abactinal surface. There are about 30 marginals from the middle of the interbrachial arcs to the tips of the rays.

Viewed on the abactinal surface the two superomarginals in the middle of the interbrachial arcs are slightly higher (radially) than broad. The one on each side of this pair is about as long as

broad, and those following soon become about half again as long as broad, in the distal third of the ray slowly decreasing in length and becoming about as long as broad near the tip, with the last few slightly broader than long. The terminal plate is rather large, broadly truncate distally with converging sides and the inner end excavated in approximately a right angle. The superomarginals bear numerous scattered thorny spinules which are separated by about their own length. The two in the middle of each interbrachial arc bear a short slender conical spine, and the one on each side of these bears two smaller spines. None of the others bear spines.

The inferomarginals are covered with scattered spinules similar to those on the superomarginals. The two in the middle of each interbrachial arc bear two median conical spines. The next 15 or 16 on each side each bear a single slender short spine decreasing in size distally, at first central and surrounded by enlarged spinules, soon losing the accompanying enlarged spinules and gradually moving to the distal end of the plates.

On the actinal surface the interactinal areas are occupied by a number of plates which are much larger than the plates of the abactinal surface and are only slightly convex. A somewhat irregular median row runs from the suture between the mouth plates to the suture between the two central inferomarginals; this includes 3 or 4 plates; except for a single plate adjoining the mouth plates, it is absent in one interactinal area. Perrier does not mention this unpaired column in his description, but it appears to be indicated in his figure of the actinal surface (1a). On each side of this there is a column of 3 plates, with a small one next the inferomarginal. Perrier says that these columns have 5 or 6 plates, but his figure seems to show 3 or 4. These columns are followed by a column of 3 plates and a very small one, then two plates and a very small one, then about 4 single plates between the adambulacrals and inferomarginals. The two median inferomarginals each have 4 columns of plates abutting against their inner ends, and those adjacent have 2 or 3. There are 3 columns of plates arising from the mouth plates, and 4 from the first 3 adambulacrals; usually 2 plates adjoin the fourth and fifth adambulacrals, followed by long very narrow plates between the following adambulacrals and inferomarginals. These plates bear usually 12–15 well-spaced spinelets scattered uniformly over the surface which resemble those of the inferomarginals and are much larger than those of the abactinal plates.

The number of adambulacrals is greater than that of the inferomarginals so that the two series do not exactly correspond until about the tenth inferomarginal, which corresponds to the thirteenth adambulacral; from this point on the two series correspond. The inner border of the adambulacrals is regularly curved and bears a comb of 9 slender spines of which the two outermost are the shortest. On the outer edge of the plate there is a straight row of 6 or 7 subequal shorter and rougher spines. In the distal third of the arms the adambulacrals develop a single long spine on the actinal surface.

The mouth plates were well described by Perrier. There are no pedicellariae.

GONIASTERIDAE

HIPPASTERINAE

Hippasteria phrygiana (Parelius)

Asterias phrygiana Parelius, Kgl. norwegischen Ges. Wiss. (zu Drontheim) Schriften, aus dem dänischen Übersetzt, Teil 4: 349, 350, pl. 15, figs. 1, 2. 1768.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. One specimen.

Notes.—This specimen is large, with R = 175 mm., r = 75 mm. The disk is subcircular and tumid, abruptly separated from the rays, which are 30 mm. wide at the base and are separated from each other by a distance of 60 mm. The rays are high and evenly rounded abactinally.

Especially remarkable is the great size of the pedicellariae. Those on the abactinal surface are 3 mm. long. On the actinal intermediate plates the numerous pedicellariae are about 5 mm. long. Each of the plates of the series between the inferomarginals and the adambulacrals bears an enormous pedicellaria; on the disk these are set at an angle of about 60° to the ambulacral groove, but on the rays they are more or less at right angles to it. On the disk these pedicellariae are from 6 to 10 (mostly about 8) mm. long; on the rays they slowly decrease to 3 mm. at the end of the series, about 20 mm. from the tips.

ASTEROPIDAE

Poraniomorpha borealis (Verrill)

Asterina borealis Verrill, Amer. Journ. Sci. **16**: 213. 1878.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. One specimen.

Note.—The single specimen is large, with R = 57 mm., r = 37 mm.

ECHINASTERIDAE

Henricia sanguinolenta (O. F. Müller)

Asterias sanguinolenta O. F. Müller, Zoologiae Danicae Prodromus: 234. Havniae, 1776.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. Thirty-one specimens.

Note.—In these specimens R = 11 to 37 mm.

Henricia lisa, n. sp.

Description.—The single specimen is in poor condition. It was completely encased in mud and ooze the removal of which resulted in the loss of most of the spines.

R = 26 mm. r = 7 mm. The form is stellate with the points of the star much produced. The arms taper rapidly to about 15 mm. from the center of the disk, thence slowly to the rounded tip. The interradial arcs form an obtuse angle with straight sides. The disk and the stout basal portion of the arms were apparently inflated in life.

The abactinal skeleton is very dense, composed of a great number of small and mostly slightly elongated plates among which are interspersed rounded or polygonal plates, especially about the papular pores, with occasional small independent subcircular plates in the interstices. Numerous single papulae occur between the plates, except in a broad line from the middle of the interbrachial arcs about half way to the center of the disk where the plates are larger and shorter than elsewhere with the inner ends elevated and imbricating, and are closely appressed against each other with no interspaces. Presumably in life this solid line of plates was depressed, forming a sulcus. All the plates are strongly and smoothly convex.

The abactinal skeleton in general resembles that of certain forms of *Henricia leviuscula*, but the plates are much smaller, lower, and more densely packed, all the papulae being single.

Each plate appears to bear a regular or irregular row of usually 3 or 4, sometimes 2 or even only 1, short and fine spines; on the plates in the interradial lines there are usually 2, sometimes 1 or 3, spines on the highest (inner) portion.

The madreporite, situated about half way between the center and margin of the disk, is large and prominent, about 2 mm. in diameter, and, in the dry specimen, is elevated above the surface of the disk. It is coral-like, but bears a number of spines scattered over its surface.

The plates of the abactinal surface are continued around the margin of the disk onto the actinal surface where they become somewhat higher with a more or less developed median crest. Except in a broad central band, a continuation of the interradial band of the abactinal surface, which reaches nearly to the mouth plates, they become aligned with their long axes at right angles to the margin of the disk and arranged in somewhat irregular transverse and longitudinal rows. The inferomarginals, scarcely distinguishable from the other plates, are separated from the adambulacrals by a single row of actinal intermediate plates which extends at the twentieth or twenty-fourth adambulacral. Near the mouth plates the plates of the actinal intermediate series are as large as, or larger than, the inferomarginals and bear a comb of 2–4 spinelets, but they soon decrease in width and become subcircular.

The two series of inferomarginals in each actinal interradial area almost meet just beyond the mouth plates, being separated by the narrow inner end of the irregular band of plates in the middle of the areas. The superomarginals are indistinguishable in these areas. There is a more or less deficient row of papulae between the inferomarginals and the actinal intermediate plates. The plates of the interradial areas bear a row of 4–6 spinelets resembling those on the abactinal surface but longer.

The adambulacral plates are short and broad, the largest plates on the rays. They bear a regular or somewhat irregular row of 6–8 spines of which the innermost (sometimes the two innermost) is abruptly larger and stouter than the others, which are short and decrease in length outwardly. At the inner angle of the plate, deep within the furrow, there is a stout conical spine, shorter than the large spine at the end of the series on the actinal surface.

The mouth plates are about three times as long as broad. The two of each pair curve about a broad central cavity, being separated at their

outer ends but broadly in contact at their tips. Each mouth plate bears a series of about 7 stout spines along the outer edge, and a similar series along the inner edge. Each pair of mouth plates has at the tip a single unpaired spine.

Type.—U.S.N.M. no. E. 7774, from *Atlantis* cruise 152, station 8; southeast of Newfoundland and west of the Azores (lat. 47° 10′ N., long. 36° 00′ W.); 2,300 fathoms; August 2, 1948.

Notes.—It is with much diffidence that I propose a new specific name in this perplexing genus, but the present specimen is so different from any previously recorded that it seems reasonable to assume that it represents a new specific type. Of all the named species and forms it comes nearest to *Henricia sanguinolenta eschrichtii* forma *tumida* Verrill as represented by some specimens at hand from the Bering Sea area, with unusually dense abactinal skeletons. But the rays are tumid only in the proximal half, the skeleton is more compact and composed of smaller plates which are evenly rounded dorsally without ridges or bosses, the marginal plates are not clearly defined, the spinelets on all the plates are longer and more slender, and the papulae are invariably single.

PTERASTERIDAE

Pteraster militaris (O. F. Müller)

Asterias militaris O. F. Müller, Zoologiae Danicae Prodromus: 234. Havniae, 1776.

Locality.—*Atlantis* cruise 152, station 6, east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. One specimen.

Notes.—The single specimen is four-rayed; R = 16 mm., r = 7 mm.

BRISINGIDAE

Freyella abyssicola E. Perrier

Freyella spinosa var. *abyssicola* E. Perrier, Expéditions scientifiques du *Travailleur* et du *Talisman* pendant les années 1880, 1881, 1882, 1883, Échinodermes: 88. 1894. One specimen.

Locality.—*Atlantis* cruise 152, station 8; east of Newfoundland and south of Greenland (lat. 47° 10′ N., long. 36° 00′ W.); 2,300 fathoms; August 2, 1948.

Notes.—The single specimen has the disk 11 mm. in diameter and the 11 rays 85 mm. long. Four of the rays, opposite the madreporite, are slightly smaller than the others.

This specimen agrees closely with Perrier's type from northeast of the Azores (lat. 42° 19′ N., long. 23° 36′ W.), in 4,060 meters, which also had 11 rays.

ASTERIIDAE

PEDICELLASTERINAE

Hydrasterias ophidion Sladen

Asterias (*Hydrasterias*) *ophidion* Sladen, *Challenger* Reports, Zoology, **30** (pt. 51): 581, pl. 99, figs. 3, 4, pl. 103, figs. 3, 4. 1889.

Locality.—*Atlantis* cruise 152, station 20; north of the Azores (lat. 37° 50′ 30″ N., long. 26° 00′ W.); 1,400 fathoms; August 18, 1948. 10+ specimens.

Notes.—All the specimens have 6 rays; R = about 35 mm.

ASTERIINAE

Asterias vulgaris Verrill

Asterias (*Asteracanthion*) *vulgaris* (Stimpson, MS.) Verrill, Proc. Boston Soc. Nat. Hist. **10**: 347. 1866.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. One specimen.

Note.—The single specimen is small, with R = 11 mm.

OPHIUROIDEA

OPHIACANTHIDAE

Ophiacantha abyssicola G. O. Sars

Ophiacantha abyssicola G. O. Sars, Nye Echinod. fra den norske Kyst., Vid. Selsk. Forh. Christiania: 8. 1871.

Locality.—*Atlantis* cruise 152, station 26; southwest of the Azores (lat. 34° 12′ 30″ N., long. 30° 12′ 30″ W.); 570 fathoms; August 26, 1948. One small specimen.

OPHIACTIDAE

Ophiactis abyssicola (M. Sars)

Amphiura abyssicola M. Sars, Norges Echin.: p. 18, pl. 2, figs. 7–12. 1861.

Locality.—*Atlantis* cruise 152, station 11; north of the Azores (lat. 42° 53′ 30″ N., long. 29 05′ W.); 720 fathoms; August 10, 1948. Two specimens.

Ophiopholis aculeata (Linné)

Asterias aculeata Linné, Syst. Nat., ed. 12, **1** (pt. 2): 1101, No. 12. 1767.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. Thirty-eight specimens.

Note.—All the specimens are small, the largest having the disk 9 mm. in diameter.

OPHIOLEPIDIDAE

Amphiophiura convexa (Lyman)

Ophioglypha convexa Lyman, Bull. Mus. Comp. Zool. **5**: 84, pl. 3, figs. 83, 84. 1878.

Localities.—*Atlantis* cruise 152, station 8; east of Newfoundland and south of Greenland (lat. 47° 10′ N., long. 36° 00′ W.); 2,300 fathoms; August 2, 1948. Eleven specimens.

Station 30; between North Carolina and the Azores (lat. 34° 53′ N., long. 46° 24′ W.); 2,530 fathoms; September 3, 1948. One specimen.

Notes.—The largest specimen from station 8 has the disk 15 mm. in diameter and the arms 30 mm. long. The single specimen from station 30 has the disk 12 mm. in diameter and the arms 24 mm. long.

Ophiura sarsii Lütken

Ophiura sarsii Lütken, Vidensk. Meddel., 1854: 101. 1855.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. Six specimens.

Note.—The largest specimen has the disk 20 mm. in diameter.

Ophiura irrorata (Lyman)

Ophioglypha irrorata Lyman, Bull. Mus. Comp. Zool. **5**: 73, pl. 4, figs. 106–108. 1878.

Locality.—*Atlantis* cruise 152, station 8; east of Newfoundland and south of Greenland (lat. 47° 10′ N., long. 36° 00′ W.); 2,300 fathoms; August 2, 1948. Three specimens.

Note.—The largest specimen has the disk 23 mm. in diameter and the arms 125 mm. long.

Ophiura ljungmani (Lyman)

Ophioglypha ljungmani Lyman, Bull. Mus. Comp. Zool. **5**: 71, pl. 3, fig. 77. 1878.

Locality.—*Atlantis* cruise 152, station 11; north of the Azores (lat. 42° 53′ 30″ N., long. 29° 05′ W.); 720 fathoms; August 10, 1948. Five specimens.

Note.—The largest specimen has the disk 6 mm. in diameter and the arms 16 mm. long.

Ophiocten sericeum (Forbes)

Ophiura sericea Forbes, Journ. Sutherland's Voy. **2**: App.: 215. 1852.

Locality.—*Atlantis* cruise 152, station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948. 203 specimens.

Note.—All the specimens are small, the largest with the disk about 5 mm. in diameter.

ECHINOIDEA

STRONGYLOCENTROTIDAE

Strongylocentrotus drōbachiensis (O. F. Müller)

Echinus drōbachiensis O. F. Müller, Zoologiae Danicae Prodromus: 235. Havniae, 1776.

Locality.—*Atlantis* cruise 152, station BT 65; 200 meters; July 21, 1948. One specimen.

Note.—The specimen is 36 mm. in diameter.

SCUTELLIDAE

Echinarachnius parma (Lamarck)

Scutella parma Lamarck, Hist. nat. des animaux sans vertèbres **3**: 11. 1816.

Locality.—*Atlantis* cruise 152, station 1; south of Nantucket, Massachusetts (lat. 40° 50′ N., long. 70° 10′ W.); 19–20 fathoms; July 16, 1948. One specimen.

Note.—The single specimen is 38 mm. in diameter.

PALAEOPNEUSTIDAE

Homolampas fragilis (A. Agassiz)

Lissonotus fragilis A. Agassiz, Bull. Mus. Comp. Zool. **1**: 273. 1869.

Locality.—*Atlantis* cruise 152, station 20; north of the Azores (lat. 37° 50′ 30″ N., long. 26° 00′ W.); 1,400 fathoms; August 18, 1948. Fragments of 2 medium-sized specimens, one living and one dead.

CRINOIDEA

BOURGUETICRINIDAE

Democrinus parfaiti E. Perrier

Democrinus parfaiti E. Perrier, Comptes Rendus **96** (7): 450. 1883.

Locality.—*Atlantis* cruise 152, station 11; north of the Azores (lat. 42° 53′ 30″ N., long. 29° 05′

W.); 720 fathoms; August 10, 1948. One specimen, without arms.

Notes.—This specimen consists of a root, stem, basals, and radials. The stem is about 105 mm. long with 55 columnals, and the basals are 3 mm. long.

BATHYCRINIDAE

Bathycrinus aldrichianus Wyville Thomson

Bathycrinus aldrichianus Wyville Thomson, Journ. Linn. Soc. (Zool.) **13**: pp. 47–51, fig. 1. 1876.

Bathycrinus serratus A. H. Clark, Proc. U. S. Nat. Mus. **34**: 205, fig. 1; 306. 1908.

Locality.—Between North Carolina and the Azores (lat. 34° 53′ N., long. 46° 24′ W.); 2,530 fathoms; September 3, 1948. One stem without the proximal portion, and fragments of another.

Notes.—The larger fragment is about 122 mm. long with 61 columnals, tapering to a diameter of 0.4 mm. at the broken proximal end. The longest columnals, near the broken end, are 1.5 mm. long and about four times as long as broad, and are cylindrical. The other smaller fragments are from a considerably stouter stem.

Prof. Torsten Gislén has suggested to me that my *Bathycrinus serratus* described in 1908 from *Albatross* station 2226, off Virginia in 2,045 fathoms, and recorded from *Albatross* station 2713, off Maryland in 1,859 fathoms, is in reality a synonym of Prof. Wyville Thomson's *B. aldrichianus*. With this suggestion I am quite in agreement.

LIST OF THE STATIONS, WITH THE SPECIES FOUND AT EACH

Station 1; south of Nantucket (lat. 40° 50′ N., long. 70° 10′ W.); 19–20 fathoms; July 16, 1948:

Echinarachnius parma

Station 6; east of southern Newfoundland and south of Cape Farewell, Greenland (lat. 47° 08′ N., long. 44° 52′ W.); 85 fathoms; July 31, 1948:

Leptychaster arcticus
Hippasteria phrygiana
Poraniomorpha borealis
Henricia sanguinolenta
Pteraster militaris
Asterias vulgaris
Ophiopholis aculeata
Ophiura sarsii
Ophiocten sericeum

Station 8; west of Newfoundland and south of Greenland (lat. 47° 10′ N., long. 36° 00′W.); 2,300 fathoms; August 2, 1948:

Dytaster biserialis
Henricia lisa
Freyella abyssicola
Amphiophiura convexa
Ophiura irrorata

Station 11; north of the Azores (lat. 42° 53′ 30″ N., long. 29° 05′ W.); 720 fathoms; August 10, 1948.

Ophiactis abyssicola
Ophiura ljungmani
Democrinus parfaiti

Station 20; west of San Miguel, Azores (lat. 37° 50′ 30″ N., long. 26° 00′ W.); 1,400 fathoms; August 18, 1948:

Dytaster mollis
Hydrasterias ophidion
Homolampas fragilis

Station 26; southwest of the Azores (lat. 34° 12′ 30″ N., long. 30° 12′ 30″ W.); 570 fathoms; August 26, 1948:

Ophiacantha abyssicola

Station 28; southwest of the Azores (lat. 34° 50′ N., long. 39° 20′ W.); 1,770 fathoms; August 30, 1948:

Plutonaster notatus

Station 30; between North Carolina and the Azores (lat. 34° 53′ N., long. 46° 24′ W.); 2,530 fathoms; September 3, 1948:

Amphiophiura convexa
Bathycrinus aldrichianus

Station BT 65; 200 meters:

Strongylocentrotus drōbachiensis

ORNITHOLOGY.—*A new race of bird of the genus* Spodiornis *from Venezuela.* ALEXANDER WETMORE and WILLIAM H. PHELPS, JR.

The curious avian species *Spodiornis rusticus*, at present placed in the family Fringillidae, is of scattered and erratic distribution in Central and South America from the mountains of eastern Veracruz in México south to northern Bolivia. In Venezuela it has been known from 10 skins of *Spodiornis rusticus rusticus*, the typical race, collected on Cerro del Avila in the mountain near

[1] Received August 19, 1949.

Caracas. A specimen taken by the junior author on Cerro Chimantá-tepui in the Guayana Highlands of Venezuela, south of the Río Orinoco, has been of especial interest for its extension of the known range to an isolated locality. After careful study we have determined this to represent an unknown form, and present its description.

Spodiornis rusticus arcanus, n. subsp.

Characters.—Similar to *Spodiornis rusticus rusticus* Tschudi[2] but blacker, more sooty gray above, and darker below.

Description.—Type, Phelps Collection no. 36,128-A, male, taken at 1,850 meters elevation near the summit on the western side of Cerro Chimantá-tepui, Estado Bolívar, Venezuela, July 13, 1946, by W. H. Phelps, Jr.; on deposit in the United States National Museum. Above blackish slate, shading to dark neutral gray on the sides of the head and rump; below neutral gray, with a slight amount of dull white in the center of the abdomen, and as edging on the larger under tail coverts; rectrices and remiges slate-black. Iris brown, maxilla black, mandible gray, tarsus brown (in life).

Measurements.—Wing 70.8, tail 46.5, culmen from base 12.1 (approximate), tarsus 19.5 mm.

Range.—Known only from the type locality near the summit of Cerro Chimantá-tepui, southeastern Bolívar, Venezuela.

Remarks.—The type, the only individual seen, was collected in low bushes near the summit of Chimantá-tepui, which is a table-top mountain of sandstone, with an area of more than 400 square miles, and an elevation of about 2,000 meters, located in the western part of the Gran Sabana region of southeastern Venezuela. The locality where the bird was found is covered with dense, subtropical plant growth, so that it is likely that the main part of the range of the form is found across the summit, where the cover of smaller trees and bushes is more open. No *Spodiornis* has been taken on the 14 other great sandstone mountains where collections have been made to date in the vast Guayana Highlands, between Roraima and Uei-tepui, on the British Guiana border, and Duida and Paraque in the region of the upper Orinoco.

The type specimen is unique but differs so definitely from a fair series of the typical form that there is no hesitance in allocating it a new name. The tip of the maxilla is broken, causing the bill to appear blunt, which serves to change the appearance of the head considerably, as these birds have sharply pointed bills. By chance the tongue has remained in place, its tip, under low magnification, being distinctly brushlike. It seemed at first that the whole tongue was fringed, but careful cleaning revealed that the fimbriate area was confined to the tip instead of continuing down the sides as at first supposed. The sharply pointed rectrices with the inner web cut away at the tip, a character of the genus *Spodiornis*, are peculiar. While placed in the Fringillidae it may be observed that the form of the tail and of the tongue suggest affinities with the Coerebidae, which in fact is the family in which P. L. Sclater originally described *Spodiornis*. A further unusual character is the posterior lengthening of the gonys so that the gonydeal angle is at the level of the posterior margin of the nasal fossae, instead of well anterior to that point as is usual in Fringillidae.

The latest treatment of *Spodiornis*, that of Hellmayr,[3] recognizes three subspecies to which the present description adds a fourth. *Spodiornis rusticus barrilesensis* Davidson, of Costa Rica, and Chiriquí in western Panamá, has a slightly larger bill, and while somewhat darker than *rusticus* is definitely lighter, less sooty gray, than *arcanus*. *S. r. uniformis* from near Jalapa, Veracruz, which has not been available for examination, is described as being larger, but the difference from *barrilesensis* seemingly is slight. According to Ridgway[4] the wing measures 76 mm, whereas Hellmayr gives it as 75 mm.

Material available for comparison (adult males only) has been as follows:

Spodiornis rusticus rusticus: ECUADOR: Sumaco Arriba, Quito, below Calacali. COLOMBIA: Cachirí and Buenos Aires, Province of Santander del Norte.

Spodiornis rusticus barrilesensis: COSTA RICA: Carrillo and Navarro.

[2] *Phrygilus rusticus* Tschudi, Arch. Naturg. **10** (1): 200. May 1844. (Perú.)

[3] Cat. Birds Amer., Field Mus. Nat. Hist., zool. ser., **13** (pt. 11): 369–371. 1938.

[4] U. S. Nat. Mus. Bull. **50** (pt. 1): 521. 1901.

HERPETOLOGY.—*A new frog of the genus* Batrachylodes *from the Solomon Islands.*[1]

WALTER C. BROWN AND GEORGE S. MYERS, Natural History Museum, Stanford University. (Communicated by HERBERT FRIEDMANN.)

In this paper we present the description of a very distinctive and beautiful little frog from the Solomon Islands, representing the second known species of the hitherto monotypic genus *Batrachylodes*. We are indebted to Miss Doris M. Cochran, of the U. S. National Museum, for the loan of the material upon which the new species is based, and to Walter L. Necker, who is working on Solomon herpetology, for his generosity in relinquishing claim to describe a new form which he himself collected.

In 1887 (p. 337) Boulenger described *Batrachylodes*, a new genus of Ranidae, on the basis of a single adult female from Faro (Fauro) Island, Solomons. This genus was defined as lacking vomerine teeth; tongue free posteriorly and only feebly indented; pupil horizontal; fingers and toes free, with large terminal disks; outer metatarsals united; omosternum and sternum with a bony style. As pointed out by Noble (1931, p. 524), the genus is apparently allied to *Cornufer* in the forked omosternum, though the opening is very small, and in the prominent digital disks. It differs in the absence of webs, vomerine teeth, and the transverse groove on the lower surface at the base of the disks. Sternfeld (1920, p. 435, pl. 31, figs. 8, 9) described and illustrated *Chaperina friedericii* and *Sphenophryne wolfi* from Buka Island, Solomon Islands. Both of these were later placed in the synonymy of *Batrachylodes vertebralis* Boulenger by Mertens (1929, pp. 266–268). Comparison of the descriptions and illustrations in Sternfeld's paper with the specimens before us indicates that Mertens was correct in his decision and that the present series of specimens represents an heretofore undescribed species.

Batrachylodes trossulus, n. sp.

Holotype.—U.S.N.M. no. 119577, adult male, collected at Torakina, Bougainville Island, Solomon Islands, by Walter L. Necker.

[1] Received July 14, 1949.

Paratypes.—Six specimens, U.S.N.M. nos. 119586–88 and 119787–89, from the type locality.

Definition.—A small *Batrachylodes* with disks of fingers round, scarcely dilated, swollen, and much smaller than those of the toes; disk of the third finger much smaller than the tympanum; forelimb and fingers very slender; lateral surface of the head and body black, this color fading out in the region of the groin but reappearing as an irregular dark bar on the inner side of the femur; ventral surface of head, throat, and pectoral region dusky red-brown (in preservative), occasionally spotted with white; the dark color extending as a diagonal bar from the shoulder across the upper arm.

Description of holotype.—Head narrow; snout moderately pointed, strongly projecting beyond the lower lip; chin with numerous small, white, hard, nuptial tubercles; vomerine teeth not present; tongue narrowly oval, not notched at the posterior free margin; nostril about equidistant from the tip of the snout and the anterior angle of the eye.

Forelimb moderately developed; fingers with swollen, round disks only slightly dilated at tip; diameter of disk of third finger about half that of tympanum; first finger not reaching the distal joint of second finger; subarticular tubercle poorly developed; inner and middle metacarpal tubercles broadly oval and moderately developed; outer somewhat smaller and not well developed; a fourth rounded tubercle occurring just posterior to the middle one and extending out beyond the inner edge of the outer one.

Tibiotarsal articulation reaches eye when hindlimb is appressed; toes without web, rather broadly expanded at the tips; disks much larger than those of fingers; subarticular tubercles moderately developed; inner metatarsal tubercle oval, elongate, its length equal to its distance from the tip of the fifth toe; outer metatarsal tubercle moderately distinct, round.

Skin smooth both above and below, and on limbs.

Color.—Dorsum gray with a tinge of pale reddish and suffused with dusky, particularly on the head; sides of head and body black with

a rather even, light-bordered, dorsal edge except on the posterior abdomen where the black color gradually disappears, reappearing as an uneven-margined, dark-brown or blackish bar on the outer surface of the thighs (when the hind limbs are extended) and as a very irregular or broken line on the outside of the lower leg; upper surfaces of the hindlimbs marked with rather narrow grayish-brown bands; belly white with a few brown spots; ventral surface of head, throat and pectoral region dark reddish brown with a few scattered small white spots in addition to the white tubercles of the chin region; darker along the lateral margins and continued as a broad irregular stripe on the anterior side of the upper and lower arm and the dorsal surface of the hand, and with a similar broad blackish stripe on the posterior side of the limb, not continuing on the palm, however; posterior proximal areas of thighs and anal region black.

Measurements of holotype (in millimeters).—Snout to vent 20, snout 3, diameter of eye 3, diameter of tympanum 1.65, length of hindlimb 30, breadth of head 6.5, length of tibia 10.

Variations and remarks.—Whereas *Batrachylodes vertebralis* from this same locality, Bougainville Island, shows much variability in both dorsal and ventral coloration, the seven specimens of *trossulus* are remarkably constant. The largest female (U.S.N.M. no. 119586) measures slightly less than 20 mm from tip of snout to vent; the smallest specimen (U.S.N.M. no. 119788), 14 mm. The small white nuptial tubercles on the chin and undersurface of the head of males also occur on the males of *B. vertebralis* from Bougainville and Ronongo Islands, which we have available for comparison.

A single specimen from Choiseul Island, Amer. Mus. Nat. Hist. no. 35425, is assigned to this species, which it fits very well on the basis of the digital disks. However, in its present poor condition, it does not show the distinctive color pattern so evident in all the specimens of the series from Bougainville. This specimen was originally referred to *Rana solomonis* by Burt and Burt (1932, p. 491).

The two species of *Batrachylodes* may be distinguished as follows:

1. Disks of fingers rounded, little dilated, scarcely or not at all flat-tipped, smaller than those of toes; breadth of disk of third finger about half diameter of tympanum or less; throat and chest dark; posterior to this undersides of belly and thighs white; sides of body covered by a wide blackish band almost to groin, on all Bougainville examples seen (one from Choiseul doubtful); a smaller and apparently a less variable species than next.... *B. trossulus*
2. Disks of fingers broadly dilated, broadly elliptical, almost flat-tipped, larger than those of toes; breadth of disk of third finger about equal to or greater than diameter of tympanum; undersides of body with a variable dusting of dark chromatophores, never as in previous species; sides of body usually with an indistinct dark area on sides of head often continued back a little way behind head, never a wide black band; a larger and more variable species than preceding..... *B. vertebralis*

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PROCEEDINGS OF THE ACADEMY

430TH MEETING OF BOARD OF MANAGERS

The 430th meeting of the Board of Managers, held in the Cosmos Club, September 19, 1949, was called to order at 8:05 P.M. by the President, F. H. H. ROBERTS, Jr. Also present were: F. B. SILSBEE, H. S. RAPPLEYE, N. R. SMITH, ALAN STONE, F. M. DEFANDORF, C. L. GAZIN, F. E. JOHNSTON, C. F. W. MUESEBECK, F. A. WEISS, W. A. DAYTON, C. A. BETTS, A. O. FOSTER, MARGARET PITTMAN, H. W. HEMPLE, H. G. DORSEY, F. M. SETZLER, and, by invitation' HERBERT FRIEDMANN, J. E. GRAF, M. A. MASON, and L. W. PARR.

The President announced the appointment on June 14 of FRANK THONE and PAUL H. OEHSER to represent the Academy on the Committee for the Science Calendar. Owing to the death of WILLIAM J. ROONEY, FRED L. MOHLER was appointed Chairman of the Physical Sciences Committee on Awards for Scientific Achievement, and

FRANK C. KRACEK was appointed as a member to fill the vacancy.

The Chairman of the Committee on Meetings, HERBERT FRIEDMANN, reported on programs arranged for the October, November, and December meetings. He raised the question as to the Board's desire concerning the annual meeting of the Academy next January. The Board recommended that the Committee arrange to have a dinner together with a speaker, similar to the January 1949 meeting.

The Committee on Membership submitted the names of nine individuals for resident membership in the Academy.

The Chairman of the Committee on Encouragement of Science Talent, M. A. MASON, reported that an agreement had been signed with Science Service to participate in the forthcoming annual science talent search. The Secretary read a letter from John R. McGonegal, a recipient of one of the Academy's Certificates of Merit for last year, indicating that he had been awarded a 4-year Scholarship in the School of Engineering at Catholic University and expressing his appreciation to the Academy for recommending him.

The Secretary read a letter from Frank Thone dated July 15, 1949, in which he reviewed the action of the Committee on Health and Research, which he attended as an observer for the Academy.

The Secretary announced the following deaths:

H. M. GOODWIN, physicist, Massachusetts Institute of Technology, Cambridge, Mass., on June 26, 1949 (elected May 17, 1915); CHARLES J. BRAND, agriculturist, Washington, D. C., on June 29, 1949 (elected January 18, 1912); P. G. NUTTING, physicist, formerly with the U. S. Geological Survey, on August 8, 1949 (elected January 18, 1912; resigned October 13, 1915; re-elected December 22, 1924; on retired list December 31, 1943); FRANK E. A. THONE, botanist, Science Service, on August 25, 1949 (elected December 1, 1939); and WILLIAM J. ROONEY, physicist, Department of Terrestrial Magnetism, Carnegie Institution of Washington, on August 31, 1949 (elected June 19, 1930).

The Senior Editor, ALAN STONE, reported that for the first six months the net cost of the JOURNAL, after deducting charges to authors, was $3,013.41, or well within half of the budget allotment for the year. These first six numbers amounted to 216 pages, an average of 36 pages per issue, slightly less than for the past two years.

There was considerable discussion on matters covered in the report on "Means of Raising Additional Funds for the Academy" by the Committee on Policy and Planning. The Board suggested that the President meet with the Committee on Membership to determine a possible solution to some of the problems confronting this Committee. As to the acceptance of advertising in the JOURNAL, the Chairman of the Committee, J. E. GRAF, indicated that, to judge from a conversation he had with the editor of one of the chemical journals, the Academy could expect only a slight income from this source. With regard to reduction in size of the JOURNAL, the Board directed that a committee be appointed by the President to look into the cost of the offset printing method and the formulation of an editorial policy for the JOURNAL, and to make a recommendation to the Board. If necessary, this committee should be permitted to make a survey of the Academy membership for its reactions. The Board accepted the report on "Means of Raising Additional Funds for the Academy" and expressed its gratitute to the Committee for the amount of work involved.

The meeting adjourned at 11:07 P.M.

F. M. SETZLER, *Secretary.*

Obituary

EDWARD RHODES STITT, honorary member of the Washington Academy of Sciences, died on November 13, 1948, in the Naval Medical Hospital, Bethesda, Md. He was laid to rest with full military honors in Arlington National Cemetery on November 16. At the time of his death he was still, at the age of 81, a commanding figure in the field of tropical medicine, a field in which he had been active for more than 40 years.

Admiral Stitt was born in Charlotte, N. C., on July 22, 1867. After receiving his A.B. degree from the University of South Carolina in 1885, he entered the University of Pennsylvania, where he studied under William Osler and received his M.D. degree in 1889. He accepted a commission in the Medical Corps of the Navy soon after graduation and during the next four years saw duty on several naval ships and at the Naval Hospital in Norfolk, Va.

In August 1896 he reported to the Bureau of Medicine and Surgery, where he served during the Spanish American War. No doubt his great interest in tropical medicine was stimulated by the responsibility of rendering medical service to people in the Tropics which fell on the Medical Department of the Navy when Guam, the Philip-

pines, Puerto Rico, and Cuba became wards of the United States after the Spanish American War.

In 1902 Admiral Rixey, then Surgeon General of the Navy, succeeded in having the Naval Observatory building at the foot of Twenty-fourth Street, NW., in Washington, D. C., turned over to the Medical Department of the Navy, and plans were laid for the Naval Medical School and a new hospital. Admiral Stitt was selected to head the bacteriological, chemical, and tropical disease departments. Admiral Rixey wrote: "His selection for the work was most fortunate as few mistakes were made and from the beginning his energy and equipment for the work relieved me of an immense amount of embarrassment."

As medical officer of the Nicaraguan Canal Commission in 1895, Admiral Stitt reported on the many, though not serious, health problems encountered and the outlook for protecting troops guarding the canal after its construction. He was ordered to London in 1905 to study tropical medicine under Sir Patrick Manson, of the London School of Tropical Medicine. Following his graduation, with distinction, from that institution, he continued his investigation of tropcial diseases in the Philippines, Guam, Japan, and Hawaii.

In 1911 Admiral Stitt completed a 2-year tour of duty as medical officer in command of the United States Naval Hospital, Cañacao, Philippine Islands, and returned to United States as medical inspector for duty in the Bureau of Medicine and Surgery and the United States Naval Medical School in Washington, D. C. His excellent training, rich experience, and ability as a teacher contributed materially to the world reputation gained by the Naval Medical School in the field of tropical medicine.

On September 18, 1916, he assumed command of the Naval Medical School and served in that capacity during World War I with the rank of rear admiral. His military duties did not prevent him from contributing to the training of Medical men not yet in the Service, for he served as professor of tropical medicine at Georgetown University and George Washington University in Washington, D. C., and as lecturer in that subject at the Jefferson Medical College in Philadelphia.

Admiral Stitt was appointed Surgeon General of the Navy and chief of the Bureau of Medicine and Surgery by President Woodrow Wilson and assumed those duties on November 30, 1920. President Calvin Coolidge appointed him to those positions for another 4-year term in 1924. Upon completion of this term he became inspector of Medical Department activities in the Eleventh Naval District with headquarters at San Diego, Calif.

Admiral Stitt contributed numerous articles in the fields of bacteriology, parasitology, and hospital administration, but he is most widely known by his textbooks *Practical bacteriology, haematology and parasitology* and *Diagnosis, prevention, and treatment of tropical diseases*. The popularity of these texts is attested by the fact that the first is now in its tenth and the second in its seventh edition.

Several institutions conferred honorary degrees on Admiral Stitt, and the Navy Cross was awarded him for "exceptional meritorious service" during World War I. He was a member of numerous medical and scientific associations, including the American College of Surgeons, the American Medical Association, the Association of American Physicians, the American Society of Tropical Medicine (president 1912), the American Association of Military Surgeons (president 1925, 1926), and the Royal Society of Medicine, and honorary member of the Washington Academy of Sciences.

Although Admiral Stitt was transferred to the retired list of the Navy on August 1, 1931, he continued to participate in many scientific and medical activities. He served as consultant to the Secretary of War during World War II and was on the Board of Directors of the Gorgas Memorial Institute of Tropical and Preventive Medicine and of Walter Reed Memorial Association.

Admiral Stitt was the son of William Edward and Mary Rhodes Stitt. He is survived by his widow, Helen Bennett (Newton) Stitt, one son, Commander Edward W. Stitt, USNR, of Trenton, N. J., and two daughters, Mrs. Warren Stephenson, of Washington, D. C., and Mrs. Herman Hudgins, of Norfolk, Va., and six grandchildren.

The regard in which Admiral Stitt was held by all his associates was well expressed by Admiral Pugh when he accepted, for the Naval Medical School, a portrait of Admiral Stitt and referred to him as "the Naval Medical Corps' premier doctor, scientist, author, scholar, officer, and gentleman."

F. C. Bishopp.